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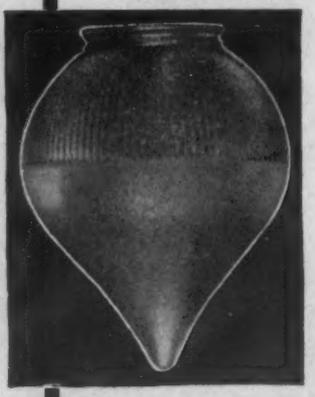

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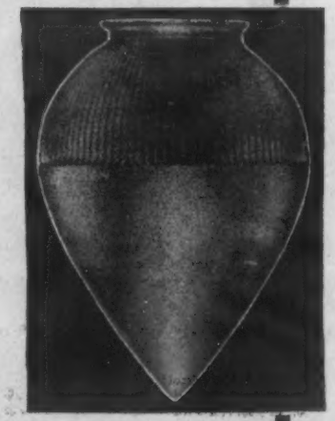

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The Engineers', Architects' and Builders' News

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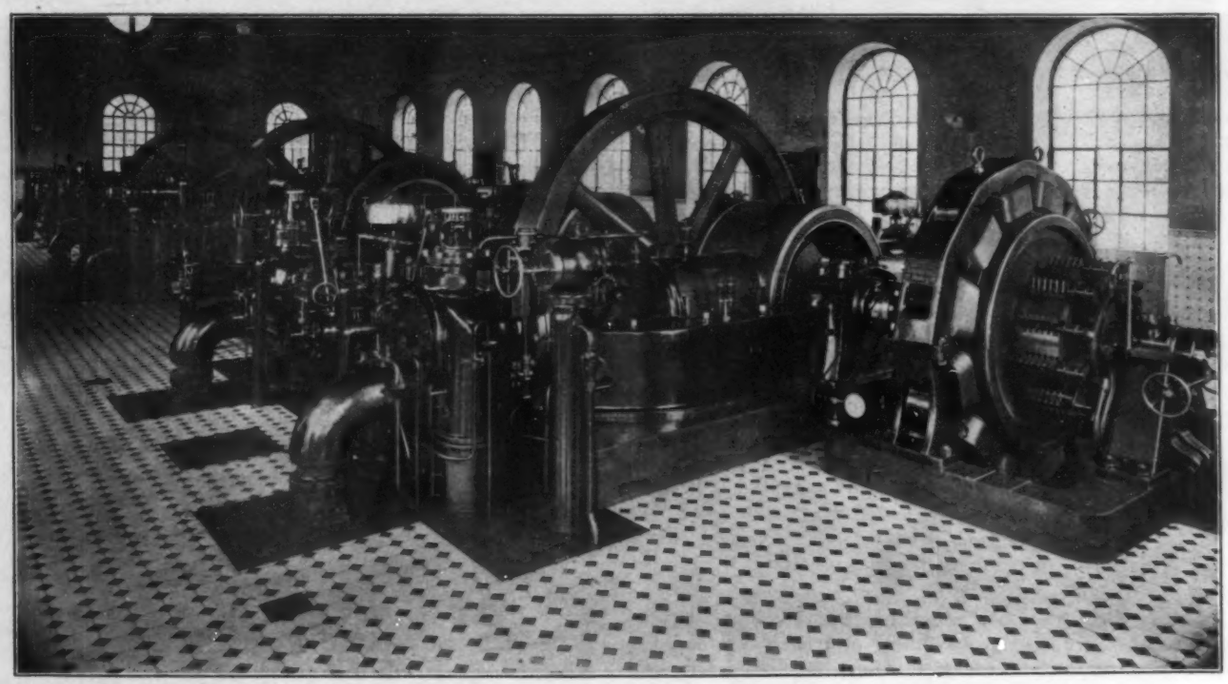
ELECTRICITY IN A GERMAN STEEL WORKS.

The use of electricity is coming more and more into vogue, in iron and steel works and rolling mills. In blast furnace works, the waste gases from the furnaces are used in engines, which in their turn drive dynamos, or, where there are coke ovens, the gas from these is used in the same manner. Where neither of these exist, steam is still employed for the purpose. Indeed, there are instances where all three methods of producing power are requisitioned.

Two central electric power stations are now working at these works. In the first (Fig. 1) are three blast furnace gas engines of the Deutz type. Each is coupled direct to a continuous-current dynamo, with an output of 1740 amperes at 240 volts (nearly 420 kilowatts) at 140 revolutions per minute. The second of these stations is driven by coke oven gas. It is coupled direct to a Siemens-Schuckert double commutator dynamo, capable of giving 2025 amperes



BLAST FURNACE GAS ENGINES AT BURBACHERHUTTE.

Electricity, when properly handled, is found to be much cheaper than any of the methods hitherto employed for carrying out numbers of operations in works where metals are manufactured and made into salable goods, and it is thus not to be wondered, that electricity is coming so much into favor.

The Burbacherhutte is among the most modern and important German steel works operated by electrical energy, and no doubt a short account of its electrical equipment will be of interest to our readers.

from each half of the machine at 240 volts, or, say, a total of 972 kilowatts at 100 revolutions per minute. The total capacity of the four machines at present at work is therefore $420 \times 3 + 972 = 2232$ kilowatts. Even this does not entirely satisfy the requirements of the works, and there is now in order, we were told, a 1250 horse-power steam turbine to work at 1550 revolutions per minute, which is to be coupled direct to two Siemens-Schuckert dynamos of 420 kilowatts each. The total capacity of electric generated power then will be of about 3100 kilowatts, that is to say, 4150 horse-power.

The double commutator dynamo is connected to a three-wire system, so that either 240 or 480 volts are available. This will also be the method of connecting the turbo-generator when it is put to work.

The Burbacher Steel Works were among the first works to employ electricity for driving rolling mills. The motors used for this purpose drive two trains of rolls for light sections. Their continuous normal full load is 410 horse-power, but they are said to be able to develop nearly double this for short periods—a necessary ability considering the heavy momentary calls which the prime mover of a rolling mill has frequently to undergo. One of the mills having to carry out particular work of a varied character, requiring

ELECTRIC GANTRY, AND PUNCHING AND SHEARING MACHINE.

some changes of speed, it has been necessary to provide for a speed variation of the motor. This is obtained by means of resistances of the shunt winding, and the range of speed varies between 230 and 300. The motor is compound wound, and is boxed up in a little room by itself so as to keep it away from the dirt and dust of the mill. The switchboard is of quite simple character, and the motor is direct connected to one train of rolls. The junction is effected by the aid of an elastic coupling on the Zodel-Voith system. The train of roughing rolls, which, of course, revolves less quickly than the finishing rolls, is driven by means of seven 2-inch ropes and rope pulleys. The pulley on the motor shaft is 8 feet, 7 inches in diameter, and weighs about 15,530 pounds; that on the roughing mill shaft is 21 feet 6 inches in diameter, and has a weight of 77,140 pounds. There is, therefore, a considerable flywheel effect, which is useful in overcoming the shocks which are always met with in rolling operations.

For starting the motor, a switch working in oil is employed, and in order to protect the motor against dangerous overloads a maximum cut-out is inserted in the main circuit. This acts automatically when the current exceeds a certain limit. Between the roughing and the finishing rolls, there is a shears which cuts the material coming from the former into lengths suitable for the latter. This particular mill is used principally for dealing with blooms from 166 to 415 pounds in weight, and transforming them into round and square iron from 1/3 inch to 1 4/5 inch hoop iron, flat bars, small profiles, T and U-irons. The production varies according to the nature of the sections, and is from 20 to 50 tons per mill in a day of twelve hours.

Each of the transfer tables in the works is driven by a series motor of the enclosed type, and is capable of having its direction of rotation reversed. Series motors are used so that the starting torque may be as large as possible, and so that the moving of the material across the table may be as quick as possible. The motors are controlled from the cabin, which also contains the starting mechanism of the mill motors.

These by no means present the only uses to which electricity is put at these works. For example, the coke is transported in trucks by an electric locomotive which is of 25 horse-power, and works at 220 volts. The railway on which these coke trains are run is nearly a mile long, and has a gauge of 2 feet 1 inch. Another use of electricity is the working of tools, cranes, etc., and an interesting example of this is an electrically worked gantry crane and a sheared and punching machine (Fig. 2). The motor for the latter is of about 20 horse-power, and works at 220 volts. It is compound wound. The total number of motors in these works is about 300, and their unit capacity is some 2550 horse-power. There are also some 4,000 incandescent lights and 300 arc lamps.

The American possesses in great degree the ability to make a living. But he possesses in a slight degree only the ability of using his leisure hours with pleasure. In short, we have not developed the art of living but have developed the business of making a living. To make a young man an artisan is all right. But public opinion should do better. It should show him how to relax and to play. There has been a vast improvement in this. The diversification of industry and the development of machinery has reduced the minimum working day to eight hours. But the other hours are often foolishly spent. If each working family possessed a home with a small acreage devoted to extensive farming and with a poultry yard and a few live stock, the increase in the productiveness of the United States would be enormous. This is one way to increase the efficiency of happiness throughout our land. A person's happiness is like the amperes of Ohm's law, his means of satisfying his desires divided by his wants. The current flow of pleasure should be increased by increasing in a rational manner the natural means rather than by decreasing the wants. With all our national wealth and greatness there is some foolishness about the lives of rich and poor save in isolated rare individuals. How to cultivate repose and to relax and divert the streams and energy in other lines—the proper balance between one's powers and his task, the proper distribution between one's physical, intellectual, and spiritual faculties, is the greatest question of anthropology.—Electrochemical and Metallurgical Industry.

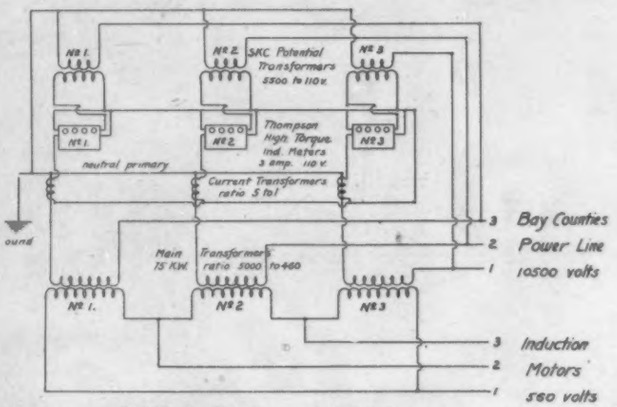
MECHANICAL ENGINEERS.

The Fifty-fourth Annual Meeting of The American Society of Mechanical Engineers will be held in the Engineering Societies Building at 29 West 39th Street, New York, December 3-6, 1907. Symposiums on foundry practice, giving the experiences of prominent men in that work, have been arranged. The specific heat of superheated steam will be taken up, a very important and exhaustive work by a Professor of Engineering at Cornell will be presented. The utilization of low grade fuels in gas producers, combustion control in gas engines, tests of producer gas engines, etc., will be given a session. Other live topics, such as industrial education, power transmission by friction driving, cylinder port velocities, etc., will be discussed.

EFFICIENCY TEST OF AN ELECTRIC PUMPING PLANT.*

The plant of the San Pablo Quarry Company at Richmond, Cal., consisted of two 50-horsepower, three-phase, Westinghouse type CCL induction motors—one on each end of the shaft of a horizontal three-stage centrifugal pump, designed and built by the United Iron Works of Oakland, Cal. The power was obtained from the Bay Counties system at about 520 volts at the motors. As the voltage on the high tension side was 10,500, and the transformers had a ratio of 5000 to 460, the best voltage for the motors was obtained by connecting the transformers star to delta, as shown in Fig. 1. This thirty per cent increase in voltage over that for what the motors were designed, would tend to lower the power-factor and to raise the efficiency. (See Elec. Jour. Vol. III, page 400). With the attendant increase in iron losses, the motors would ordinarily tend to run hot, but this trouble was not noticed in this case.

The three-stage centrifugal pump drew its water through a twelve-foot lift directly from the bay. The suction was 205 feet of eight-inch standard cast-iron pipe. The salt water used by the pump was found to weigh 64.1 pounds per cubic foot. The pump discharged into a cast-iron pipe



High Tension Transformer Installation
San Pablo Quarry Co.

Figure 1.

with foot check valve and pressure gage, as indicated in Fig. 2. The water was carried up the hill to the giant nozzle through nine-inch No. 16 sheet steel pipe. The average running pressure on the foot gage was about seventy-five pounds. The giant nozzle was hung on a semi-universal joint (see Fig. 3), and was used to turn the water onto the loose earth to wash it from the rock below. The earth was thus moved down to the bay for eight or ten cents per cubic yard, where it would have cost seventy or eighty cents with teams and scrapers.

Transformer Test.

Three 75-kilowatt transformers supplied the power to the two motors, thus working at about quarter load. As shown in Fig. 1, the input to the transformers was measured by three Thompson high-torque induction watt-meters. In the test they ran for eight hours, and showed a total power consumption of 550 kilowatt hours, or an average load of 68.75 kilowatts on the transformers. One Weston indicating watt-meter with a multiplier of 3.44, one 600-volt volt-meter, and a 150-ampere ammeter, were available to measure the output of the transformers. Measurements of volatge and current showed the load to be balanced, and as the load was practically constant, the one watt-meter gave good results for the output by switching the voltage leads and taking two readings in quick succession. The power-factor in this test ranged from fifty-three to sixty-nine, and the corresponding voltage from 598 to 548. The average load for the eight hours as shown by the watt-meter and checked by the ammeter and volt-meter, was 64.4 kilowatts, giving a combined transformer efficiency of ninety-four per cent. This seems low, but can probably be accounted for by the low power factor and by the underload conditions of the test.

Motor Tests.

In the test of the motors the Heyland method was chosen on account of its adaptability to this particular case. The pump house was in a very inaccessible place, and the plant could not be shut down except for irregular periods during low tide. The Heyland method required only the disconnection of the motors from the pump shaft, thus

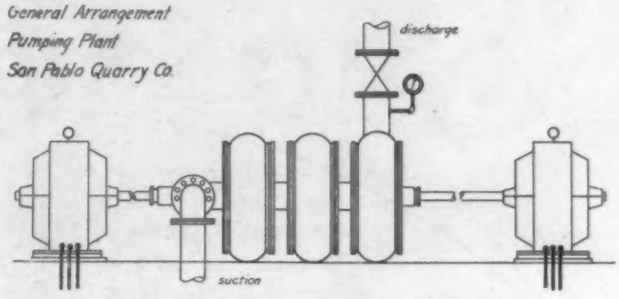


Figure 2.

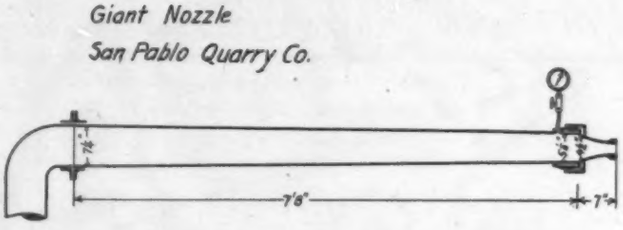


Figure 3.

making it possible to finish each part of the test during a low tide period.

Both motors were tested throughout, but gave results almost exactly alike, so that the digram and curves were constructed for only one.

In the running light test, the motor was disconnected from the pump shaft and allowed to run freely with full voltage applied. The high voltage necessitated the use of multipliers with the Weston indicating watt-meters, so for true results in the following readings, W′ must be multiplied by 4, and W″ by 4.18. The voltage was read on all three phases by means of a Weston 600-volt volt-meter and volt-meter switch. All three phases were alike.

W′	W″	Volts.	R. P. M.
2.3	1.7	520	896
2.28	1.7	...	...
2.4	1.81	...	895
2.28	1.68	...	...
2.34	1.76	...	...
2.4	1.79	...	...
2.33	1.74	520	895. Average.
9.33	7.273	520	895=True Results.

*Submitted as a Thesis, University of California, May, 1907, by Hal M. Hall, J. Grant de Remer, H. E. Sherman, Jr.

True power=$W'+W''$=9.33—7.273=2.06 KW.=P.

I=amps. of energycurrent=$P \div \sqrt{3}E = \frac{2.06}{\sqrt{3}520}$=2.33 (=CC° on Fig. 4)

Tangent of angle of lag=$\beta \frac{W'-W''}{W'+W''}$=13.65

Then the angle of lag=85.8°

Power factor=cosine (85.8°)=.073

i=no load current=$\frac{2.33}{.073}$=31.9 amps. (=AC° on Fig. 4.)

In the locked test a large pair of chain tongs was hooked onto the coupling, thus keeping the rotor still. Full voltage could not be applied on account of the excessive heating, so the auto-starter (each motor having one) was left in the first starting position, giving about one-third voltage on each of the phases. Some trouble was experienced from improper contacts in the starting boxes, but by remedying this and taking the readings as soon as possible, everything went well.

The watt-meter and volt-meter readings must be multiplied by two on account of multipliers used.

W'	W''	A	V'	V''	V'''
15.	1.5	175	95.5	87.5	92.5
15.	1.5	175	95	87	91.5
14.6	1.3	172	94	86	90.5
14.5	1.1	182	96.5	88.5	93.
15.02	1.4	175.5	95.2	87.25	91.62 Averages.
30.04	2.8	175.5	182.72 Actual Values.		

I'=Energy Current=$\frac{P}{\sqrt{3}E}=\frac{32.84}{\sqrt{3}.182.72}$=104 Amps.

Cosine of angle of lag=104 over 175.5=.593

I=Locked test current if full voltage had been applied.

=$\frac{520}{182.7}\times 175.5$=500 Amperes.

Heyland Diagram Construction.

1. Draw AB, representing the applied E. M. F.
2. Erect AD perpendicular to AB, and draw XY parallel to it at a distance CC°=2.33 Amps.=Energy Current. (Current scale,—1"=50 Amps.)
3. Draw AC°=31.9 Amps.=the no load current.
   Note: These angles are the ordinary construction for phase relations between E.M.F. and current,—i. e. CC° divided by AC°=cos angle of lag=.073.
4. AC^k=500 Amps.=current, locked, at full voltage; and so that cosine of angle (C^kAB)=.593.
5. Connect C^k with C, erect a perpendicular bisector of it, and at its intersection O with AD take center for arc CC^kD which is the input circle.
6. Join C^k to D, and drop perpendicular on C^kD at D to line through O, meeting it at O_I which is center for the arc $CF''D$, the output circle.
7. To get the distance C^kE^k.

AD=12.85 inches=520 volts.

DC^k=7.65 in.=$\frac{7.65\times 520}{12.85}$=309 volts=drop in rotor and stator.

R=0.234 ohms per phase as measured with a Wheatstone's Bridge.

C^kE^k=IR=500×.244=122 volts drop in primary.

=$\frac{122\times 7.65}{309}$=3.02 inches.

8. Join E^k to C; erect bisecting perpendicular cutting OO_I at O_E which is the center for arc CE^kD,—the torque curve.
9. Draw C^kS perpendicular to O_ED, for slip.

To read values:—

Let AC'=full load current=52.5 Amps.

Join $C'D$, cutting torque circle at E' and Output Circle at F', and cutting SC^k at S',

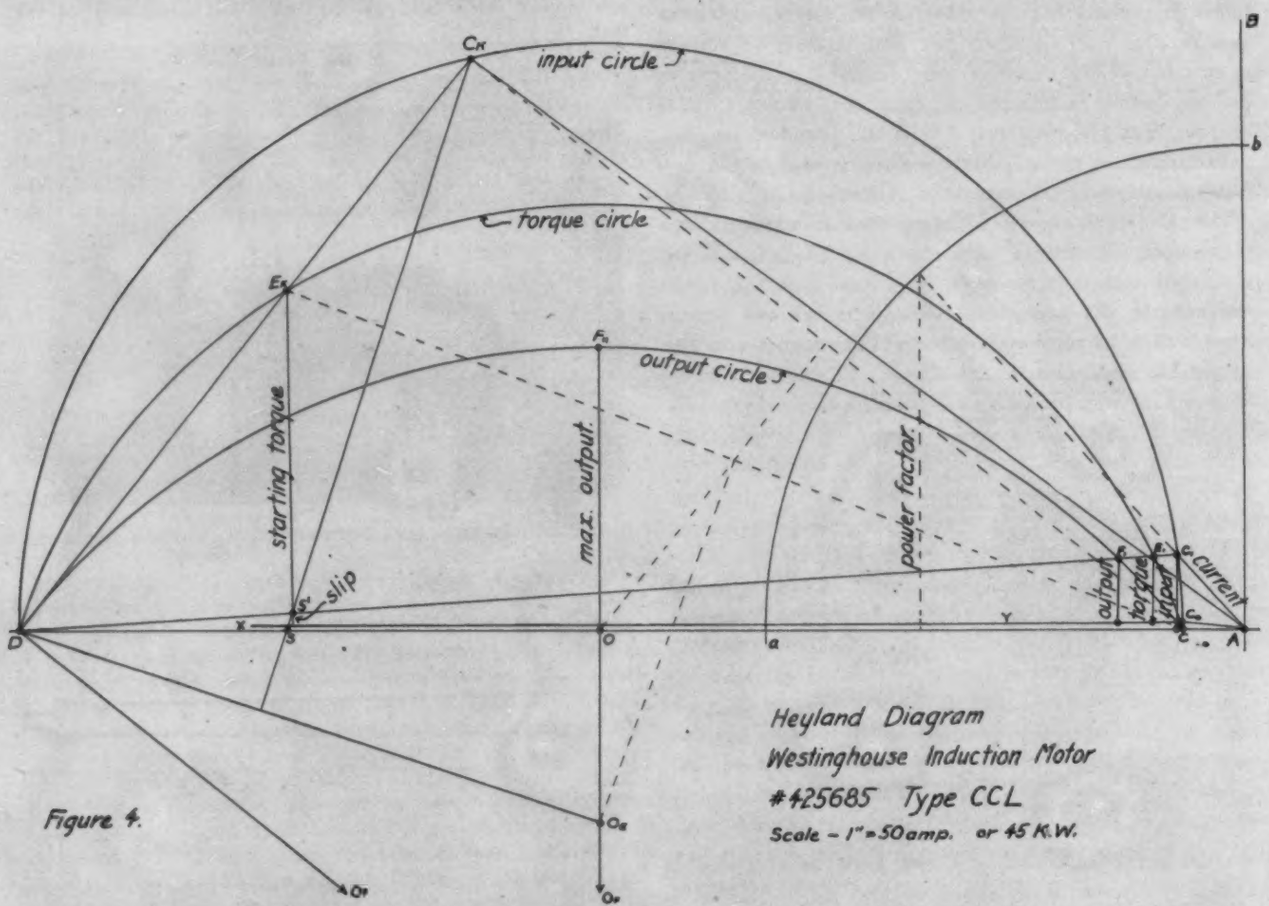


Figure 4.

Then perpendicular distance from C' to AD=input;
E' to XY=torque.
F' to XY=output;
$\frac{SS'}{SC^k}$ += % Slip.

For power-factor take arc ab with center at A; extend AC_1 to it, and drop perpendicular from this intersection to AD. The power-factor is this perpendicular divided by the radius Aa.

Scales:—

1 inch=50 Amperes.

AC"=500 Amps.=10 in.=500.√3.520=450 KW.

1 inch=45 KW.=Power scale.

Torque per inch=$\frac{45\times 33000}{2\Pi\times 746\times 900}$=352 pounds.

Values were taken from the Heyland Diagram, and plotted on rectangular co-ordinates, as shown in Fig. 5. The power-factor, percentage of slip, efficiency, input in KW., and current in amperes, are all plotted as functions of the output in KW.

The following readings were taken directly from the Heyland Diagram and used to plot these curves:

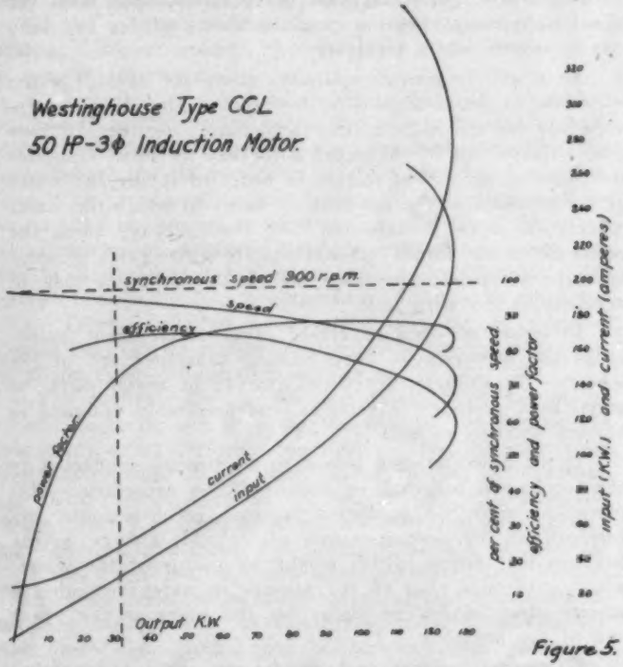


Figure 5.

KW. Output	KW. Input	Current Amps.	Torque Lbs. Ft.	Efficiency %.	Power Factor.	Slip %.	R. P. M.
0.0	2.1	31.9	00	00	.073	00	900
17.3	20.7	40	141	83.5	57.8	1.9	883
31.1	35.8	52.5	257	86.9	75.8	3.18	871
42.3	48.6	65	352	87.1	83	4.32	861
50.7	58.3	75	412	87	86	5.3	852
92.8	114	140	810	81.1	90	11	801
116	161	200	1105	72	894	17.4	747
128	196	250	1300	65	868	23.4	693
129	215	281	1410	60	85	27.8	648
128	235	317	1480	55	824	31.7	612
115	256	362	1980	45	784	42.2	522

Line Loss.

In the hydraulic tests, the power input had to be measured at the transformer house, where the combined input to the two motors could be measured with one set of instruments. The line loss had to be taken into account, and was measured as follows:

The line consisted of 280 feet of three wires, each No. 0 copper, and 192 feet of six wires, each No. 4 copper, two being in parallel and these two connected in series with one of the No. 0 wires.

Resistance,— 280 ft. No. 0= .0275 ohms.
192 ft. 2 No. 4 in parallel=.0238 ohms.
R for one conductor= .0513 ohms.

In the hydraulic test the power input was measured on the low tension side of the transformers, and input to motors is then equal to measured power minus the line loss.

Hydraulic Test.

In the following calculations the load was assumed balanced, one ammeter and one wattmeter being used; the voltage of the various phases was thrown onto the wattmeter by means of a voltmeter switch. The motors were found as stated above to be practically identical in regard to efficiency, etc., hence the power input into each motor is below assumed to be one half the power delivered to pump house.

Four complete tests were made on the plant, and they are numbered correspondingly. The electrical input was easily measured with the wattmeter in the transformer house. To measure the output of the pumps, the quantity discharged and the working head had to be measured. The suction lift was measured with the help of a level, and the discharge had a calibrated test gage as shown in the figure. To measure the quantity, the nozzle was fitted with a pressure gage as shown in Fig. 3, and used somewhat as a Venturi meter.

$$\text{h.h.p.}=\frac{\text{Quantity}\times\text{density}\times\text{head}}{550}$$

Let d'=diam. at gage=5⅛ inches. a'=.143 sq. ft.
d =diam. of main pipe=8+ in. (not needed.)
d°=diam. of nozzle=2". a°=.02182 sq. ft.
Let k=nozzle coef. (assumed)=.06
Assume 1% loss by leakage.
Then $p'/s+v'^2/2g=c^2/2g\times(1+k)$
Where p'=pressure at gage, s=density of water=64.1
v'=vel. at gage, g=accel. due to gravity,=32.17 ft./sec.
Substituting and solving for v' we get
$v'=.1501\sqrt{(p')}$ where p'=lbs. per sq. ft.
$=1.805\sqrt{(p')}$ where p'=lbs per sq. in.
or, v'
Then the actual quantity=Q=(1/.99) a'v'
a'=.14326 sq ft.
$Q=.2612\sqrt{p'}$
H.H.P. output of pump=$(h+(v^2/2g)(1+fL/d)+(p/s)(Qs/550)$
where f=coef. of friction in suction.
h=suction head in feet as measured with level.
v=velocity in suction pipe.
L=length of suction=205 feet.
d=diameter of suction=.66666 feet.
p=pressure on discharge at pump.
(to get p, add 1.06 pounds to the gage reading.)

POWER SUMMARY—ELECTRIC.

No.	Put Into Transformers	Put Into Line	Line Loss H. P.	Put Into Motors	Input to Pump
I.	93.1 H.P.	87.5 H.P.	2.46 H.P.	85.04 H.P.	73.9
II.	89.6	85.1	3.06	82.04	71.7
III.	87.4	82.25	2.21	80.04	69.9
IV.	82.0	77.0	2.24	74.76	64.6

Input into transformers=measured power divided by .94.
Input into Motors=Measured power—Line loss.

HYDRAULIC POWER SUMMARY.

No.	Suction Ft.	Nozzle Press	Vel. at Pump	f	Vel. Head Ft.	Discharge Press	Work- ing Head	Quantity Sec.Ft.	G.P.M.	H.H.P.
I.	12.0	34.68	4.38	.0231	.301	76.69	119.7	1.538	690	24.0
II.	10.75	30.0	4.08	.0233	.260	79.06	123.3	1.43	642	21.32
III.	10.17	22.91	3.57	.0237	.199	82.73	186.0	1.25	561	29.21
IV.	12.17	12.5	2.64	.0245	.108	88.66	199.1	.923	414	22.87

f=coef. of friction in suction pipe.

EFFICIENCIES.

No.	Plant	Transformer	Line	Motors	Pump	(Head)
I.	25.8	94	97.5	86.5	32.5	119.7
II.	23.8	94	96.8	87.0	29.7	123.3
III.	23.4	94	97.7	86.9	41.9	186.0
IV.	27.9	94	97.0	86.5	35.4	199.1

Plant Eff.=H. H. P. divided by E. H. P. on high tension.
Motor Eff. taken from diagram.

NOTES ON HYDROELECTRIC PLANT ORGANIZATION AND OPERATION.*

By Farley Osgood.

In order to discuss the several branches of hydroelectric plant organization in logical sequence, it seems desirable to divide the subject into two general headings: physical and personal. The general heading physical organization may be more closely followed under the subdivisions: hydraulic, power station, and line.

Hydraulic Department.

The first matter to consider on the hydraulic end of a system is the amount of water available for power. If the source of power is of such magnitude that only a portion of the available water is needed to fulfill the requirements of a proposed development, the study will be along different lines from a development which is to take the entire discharge of a river or reservoir system. Unfortunately for those interested in water-power possibilities, there are not many sources of supply which will satisfy the demands by the use of but a portion of the water obtainable. As the greater percentage of power developments require the use of the entire source of water supply, this paper will deal with such types of installation.

The department of Geological Survey of the United States government has accumulated a vast amount of data regarding stream-discharges, drainage-areas, etc., throughout the whole country, and there are few powers under consideration which are not at least partly covered by information easily obtainable and of great benefit to the investigating engineer. With government records in hand, a careful study of the surrounding country, of a possible site, should enable the investigator to determine the limitations of development.

The minimum and maximum discharge must be determined, and then the intermediate periods worked out to show the number of months in which the average or mean discharge is available for practical purposes. This is best shown by the plotting of curves based on calculations giving daily discharges; and the study should cover a period of as many years as can be covered by accurate information. The maximum discharge can seldom, if ever, be fully utilized; the minimum discharge must be guarded against; and the conservative mean discharge will be used as a basis for determining the canal section, sizes of water wheels, etc.—all, of course, to be considered together with the amount of fall obtainable.

Having decided that a water power will warrant development, the next step is to study the most advantageous location of the plant. There must be a dam; that is, when the entire supply is to be utilized, and the dam must be so placed and constructed that it can never be carried away by floods, ice jams, or other abnormal conditions. Generally speaking, dams of to-day are built of concrete, many solid, some rock-filled, and several hollow; in the latter type the concrete being merely a shell, as it were, reinforced with steel. The ideal dam location will have ledge for a base, and ledge to which to tie each end of the dam, but as this is by no means always possible, false floorings, deep-front cut-off walls, long wing-walls at the ends of the dam, and many other special features have to be resorted to for the sake of security.

If a sufficient fall is obtainable at the chosen dam-site the development will be a simple one, so simple perhaps that a portion of the dam may be used as one wall of the power station, thus enabling the engineer to make the least expensive design of a complete hydraulic plant. Usually a canal is necessary in order to get the full benefit of all possible head. This canal may be an open one, or a wooden or metal tube. When practicable, the open canal is the least expensive. Many developments necessitate a tube, especially in cases where the storage-pond is at the top of a mountain and the power station at its base. Wooden tubes reinforced with metal hoops are common throughout the Northwest, but eastern practice seems to favor the metal tube. If an open canal is decided upon, it is desirable to have a waste-gate arrangement ahead of the intake or controlling gates of the canal proper. This is especially true when the spillway of the dam is a short one, as sudden rises of a pond may be difficult to control; but if the location of the dam is such that the natural discharge-area of the pond or river can be considerably increased, the provision for wasting water ahead of the controlling gates is not really essential. If the development is to include waste-gates, a metal gate is preferable to a wooden one on account of its strength and greater ease of operation. A stop-log arrangement at the mouth of the canal cut will make it possible to dry the canal section ahead of the canal controlling gates, thus making it possible to make repairs to all the gates in the headworks. If waste-gates are used, it is a good plan to have one of them open from the top down, thus taking off surface debris, while the other gates should open from the canal bottom up, thus ensuring the ability to dry the head works section when necessary.

It is well to provide spillways along the canal, the top elevation of which should be lower than the elevation determined for the berm of the canal bank. At the lower or power-house end of the canal a forebay or small reservoir development is a good feature in order to steady the water at the entrance of the penstock or flume to which the water wheels are directly connected. All the spillways along the canal and at the forebay should contain waste-gates in order to make it possible to drain the canal quickly in case of accident to any part of it.

In either an open or closed canal development, trash-racks are necessary to keep floating substance out of the wheels. Trash-racks are usually made of metal slats, or metal bars, arranged in sections, and preferably designed in vertical sections as well.

If the power station is not to be directly connected to the forebay, a penstock or flume will be necessary. This penstock must be protected against water-hammer occasioned by the sudden release of, or wide swings in, the load on the station, which would, by means of the water-wheel governors, shut off the passage of water through the wheels, thus leaving no outlet for the water at the lower end of the penstock.

This water-hammer, or hydraulic ram effect, is overcome in two ways; first, by the use of a relief-valve near or at the lower end of the penstock, this valve to be set to operate at a pressure slightly higher than the normal operating pressure on the penstock; secondly, by the continuation of the penstock at its lower end to a perpendicular height equal to the elevation of the water-level in the forebay—the continued section usually to be of a somewhat smaller area than the main penstock.

To guard against the rather unusual occurrence of having the penstock in danger of collapsing due to the water being suddenly taken from it, it is desirable to place one or more vent-pipes at the upper end of the penstock. The vent should be large enough to perform its duty when called upon, a fact not always appreciated by the designing engineer. The vent-pipe should be encased and kept from freezing. If a stand-pipe is part of the outfit, it should be encased and kept from freezing, and the surface-water at its top should receive sufficient heat to keep it open. The heating of the stand-pipe may be easily accomplished by either steam or electricity; it is best handled by having it included in whatever system is used to heat the power station.

*Condensed from transactions of the American Institute of Electrical Engineers.

It would at first seem proper to include the water-wheels in these notes on the hydraulic department, but as the wheels really form part of the power-station equipment, and are usually wholly or partly within the walls of the building, they will be considered under that classification.

Power-Station Department.

Without question the current will be alternating. General practice favors three-phase current. As street lighting is apt to be a feature, the generating will be at a high number of cycles; 40 at least, and usually 60. Railway men prefer 25 cycles, of course, but that part of the load can be made a sub-station study.

The principal factor in determining the transmission voltage is the length of the proposed line. If the field of work is near at hand a low voltage may be desirable, even as low as 10,000 volts, or in special cases 6600 volts. Under such conditions step-up transformers are unnecessary, for a machine voltage up to 11,000 volts is entirely within the limits of good practice. If, however, many miles of line are required, the transmission voltage should not be lower than 24,000 or preferably 33,000. Perhaps 50,000 or 60,000 volts would be better to meet all the conditions. As 33,000 volts is a very common transmission voltage, we will continue under the assumption that these notes bear on plants of that or a higher voltage, thus bringing in the necessity of step-up transformers.

As a rule, it is not advisable to have the generator voltage above 2300 volts, unless the generators are to have a very large kilowatt capacity, say over 2000 kilowatts. The water-wheel and the generator must be considered together, for an arbitrary specification feature of one might well be beyond the mechanical or electrical possibility of the other. When generator requirements and water-wheel limits cannot be brought into a reasonably close relationship, then gears and belts have to be resorted to, and that is not desirable. Direct-connected work is the best, but an engineer should not ruin his station by impractical arrangements just to obtain direct-connected prime movers.

The available head is the first point of interest to the wheel designers, and secondly the flow of the stream. In low heads, and therefore moderate pressures, the wheels are sometimes placed in chambers in the forebay or headrace, the shaft running through the station wall, the generator being direct connected to it. When possible, this makes a very good arrangement, but provision should be made to shut the water out of these wheel-chambers, and also to drain these chambers in order to get at the wheels for inspection and repairs. As this arrangement of wheels will start with the opening of the turbine-bucket gates and draught-tube, it does away with the necessity of hydraulic-valve-operated gates, or in fact all other gates, which is greatly in its favor. In a fairly high-head development a penstock is required and the wheel-chamber scheme is impracticable.

In high-head work the wheels are usually inside the power station building and are encased in a large metal chamber used as a water-jacket. This arrangement will require some sort of a gate within the station, and it will be best to have the gates hydraulically operated, but care must be taken to have the operating device large enough to do its work unhesitatingly. It is well to have a second gate outside of the building in order to keep water out of the wheel-cases when the interior gate needs repairing.

A by-pass around the gate is essential in this type of wheel, in order to fill the water-jacket of the wheel before attempting to raise the interior gate, thus helping to equalize the pressure on each side of the gate, and greatly relieving the gate-raising equipment. This by-pass arrangement can be cast in the gate and controlled by a hand-operated valve. This scheme is preferable to a pipe and valve tapped into the intake pipe and wheel-case.

An electrically driven device can be used to operate these wheel-gates, the motor being driven by current from the exciters, thus putting the matter in the hands of the operator—a desirable thing in case of accident to a wheel requiring a quick shut-down. In very high head-work impulse wheels are used, the governors being used to deflect the stream from the nozzles rather than to open or close a gate equipment. There are many makes of good water-wheels in America, the choice is merely the decision as to the wheel best suited to the conditions at hand.

The water condition again becomes a factor when determining the capacity of the generator units, for it is desirable to have at least one unit which will be about equal to the minimum kilowatt output of the stream during periods of low water. It is advantageous to have all units of an equal capacity, but in low heads, with streams of great difference in minimum and average flow, this is often impossible. If all units are of equal capacity, it makes them interchangeable and thereby greatly reduces the stock of extra parts to be carried.

The exciting units should be of sufficient capacity to run the whole station with but one exciter. Individually driven exciters are without question the best type. An exciter driven by a larger unit necessitates the wasting of water. If for any reason the larger generator is unable to carry its portion of the load—and all machines require attention and repairs—the arrangement of each generator carrying its own exciter is a poor one, for if the water-wheel speed is affected, or the generator speed is momentarily changed by load fluctuations, then the exciter voltage follows the change.

The location of the exciters is largely determined by the location of the operating switchboard, as the exciting machines should be in sight of the operator at the switchboard.. The best location for the switchboard is on a gallery high enough from the floor to allow the operator to see all machines at once. The switchboard, if it does not extend the entire length of the gallery, should be in the center; in such cases the water-driven exciters will be most easily observed if directly opposite the center of the gallery, with the electric driven exciter, if one is used, on the gallery. If for any reason the switchboard must be on the floor, the exciters should be in sight from it; if the switchboard has to be at the end of the building, as is sometimes the case, have the exciters on the end instead of in the center of the station.

Water-wheel governors give the best results when placed as near the wheels as possible; they should be electrically controlled from the switchboard, thus making it possible for the operator instantly to change the action of a governor.

If the conditions will permit of a gallery, a very comfortable layout can be planned. The low-tension bus-bars are well out of the way, yet accessible, if placed overhead at the back of the gallery. If such an arrangement is chosen, it is a convenience to have each set of bus-bars at different heights from the floor, but not over one another. The low-tension bus-bars can also be well arranged if placed in hangers just under the floor of the gallery, although in this arrangement the switchboard wiring cannot be so well cared for, as proper bus-bar clearance must be provided.

Between the machines and the bus-bars there should be both knife-switches and oil-switches, the former to protect the latter, as sometimes an oil-switch fails to act properly. The oil-switches should be motor-driven, but the hand-operated oil-switches are cheaper and are safe for low-tension work.

All cables should be carried in ducts or troughs, and these conduits should be so arranged that they cannot retain water should any get into them accidentally. Where the cables are carried along walls, it is good practice to run them between cement panels, which oftentimes are enclosed except at the cable supporting points—where square holes are left—to enable the operator to inspect or change a sup-

port. The oil-switches are well located if placed under the gallery, though some operating engineers prefer them on the gallery directly underneath the low-tension bus-bars. Oil-switches are, of course, placed in individual chambers, often iron, and just as often brick or cement. It is not an unusual practice to close in the front of the chamber with a metal curtain, but by so doing the action of the switch is concealed. It is far better to have a thick-glass panel in the front of the switch-chamber, this glass to be set preferably in a metal frame. These frames can be built to contain a light of glass for each phase of the oil-switch, thus making it possible for the attendant to see the switch at all times, which is desirable both for mechanical and personal reasons.

A good position for the generator field-rheostats is on the gallery at the back, or immediately back of and above the switchboard. In any event, rheostats should not be placed under the gallery floor so that the heat from them will heat the floor of the gallery.

The switchboard is best located in the center of the gallery and far enough back to enable the operator to pass in front of it without danger of his clothing coming in contact with any apparatus on the board, so he can safely turn his back on the switchboard when he is watching the action of the equipment on the floor of the station.

The voltage-regulators can be placed on a panel in the switchboard, preferably on or next to the exciter panels, or they can be hung on supports at the end of the switchboard.

The synchronizing device should be placed so as to be visible from the governor of every unit. In long stations two synchronizing indicators are desirable, being hung to swing at each upper corner of the switchboard.

Automatic line devices are essential, and excellent results are obtained by the three-phase bellows type time-limit overload relay, the same to close the circuit on the motor operating the line oil-switch, thus opening the line. The device itself can be placed on the back of the line panel of the switchboard, but the transformers for the relays should be placed immediately back of the low-tension side of the step-up transformers. This placing of these relay transformers is particularly desirable when there is more than one transmission line and the lines are operated in parallel.

If the relay transformers are not placed on the line side of the oil-switch, especially the paralleling-switch, there will be a flow of current through the paralleling-switch, which will at times make the relay fail, or at least so delay action that its service is too late, often causing uncomfortable results.

Many engineers prefer to have the high-tension chamber of a development in a separate building; this is not necessary, but the high-tension room should be entirely separated from the operating room by a heavy fire-proof wall, either brick or concrete. A suitable layout of the high-tension chamber of a power system is of great importance, the chief requisite being plenty of room. In three-phase systems, single-phase step-up transformers should be used, and the oil-filled water-cooled type is the best. The equipment connected to the high-tension end of the system and to the transmission lines receives the greatest insulation strains, and an oil-filled water-cooled transformer has a much higher insulation breakdown point than an air-blast transformer.

If the transformers are subjected to abnormal pressures, as in the case of lightning storms, surges, etc., it is unusual to have more than one fail, as the very failure discharges the disturbing high pressure; therefore, if single-phase transformers are used, the station loses the capacity of but one-third of the bank, and if spares are not available, the remaining two transformers may be re-connected and put into service. If three-phase transformers are used, much inconvenience may result from a breakdown. Single-phase transformers are more costly than three-phase, but the money is well spent.

The cables from the line oil-switches will terminate in some sort of a bus-bar arrangement, to which will be connected the low-tension leads of the step-up transformers. These bus-bars should not be supported on hangers fastened to the transformer cases, but should be placed on the wall back of the transformers or on a separate bus-bar supporting frame.

The terminals of the transformer leads should be split or of some quickly detachable type, or else much time will be wasted in getting an injured transformer out of service and making the re-connection of the remaining two of the bank.

Between the step-up transformers and the high-tension bus-bars come the multiple-switches, or the switches so connected as to make it possible to cut in any bank of transformers on any outgoing line. These switches are usually knife-switches, although in very large developments high-tension oil-switches are used.

Just before the lines leave the high-tension room are the taps to the lightning arresters. Some engineers prefer to have the protective devices in a separate building, but if the high-tension chamber is well arranged it is perfectly safe to install the arresters in it, and it is a good thing to have the action of the arresters observed by the operator.

Reactance or choke-coils in the line between the arrester taps and the high-tension bus-bars have been proved to be of great benefit, many a bus-bar insulator and transformer lead having been saved by their use.

Line Department.

A few years ago the question of material for a pole line was scarcely given a thought, as wooden pole construction was a universal practice. Experience brought out the fact that the poles which lasted the longest were of wood indigenous to the locality in which they were used. Wooden pole lines through the South were subject to attacks from insects of various kinds, and the high voltages coming into favor set the wooden poles on fire when an insulator failed, and so metal poles became desirable and in many cases a necessity.

The question of copper or aluminum conductors is still an open one, there being many points in favor of each. There is not a great saving in the use of aluminum, as the market price is governed by the market price of copper. The electrical properties of aluminum, as compared with copper, make it necessary to have nearly twice the sectional area in an aluminum conductor, so, all things considered, the net financial result is not so greatly in its favor as is generally supposed. Copper is more quickly obtained on orders, but aluminum is more quickly put in place, as it is so easily handled on account of its lightness. Practice indicates that a copper conductor will remain intact at the point of an arc for a longer time than will aluminum, and while this is a good feature on a wooden line—it may burn off the cross-arm, and thus clear the trouble—it is impossible on a complete metal line, as there is nothing to burn off and a sustained ground on the line may bring failure elsewhere in the system.

Porcelain insulators have proved to be the best type for high-tension work, on account of their superior mechanical strength and ability to withstand great temperature changes.

A telephone service between the power station and the sub-stations on a pole line other than the transmission line is practically a necessity, as during times of trouble on the transmission line the telephone line on that pole line is put out of commission or is at least unsafe, and it is during times of trouble that the telephone service is most wanted.

THE COPPER SITUATION.*

By James Douglas.

There has been for the last ten years an average rate of 84 tons of iron consumed to 1 ton of copper. The world's demand for the two metals was in the same ratio, and the world's production of copper also shows a notable percentage decrease. The production was in 1897, 405,350 tons, and in 1906, 718,368 tons, or an average increase for ten years of 4.3 per cent, whereas between the production of 1905, which was 699,504 tons, and that of 1906, there was a gain of only 15,754 tons, or 2.03 per cent; hence the rise in price. That iron did not sympathize in price is due to the fact that the undeveloped resources of iron ore and the metallurgical appliances for its reduction to metal, are much greater than those of copper. Consequently, iron can bear a temporary strain better than copper. Moreover, the standard price for iron has been fixed at a figure high enough to compensate for wide variations in the market.

Between the price of rails early in 1897 of $16 per ton, and the present price of $28 per ton, there is, however, as wide a difference as between the price of copper in 1896, $10.88, and the price of copper in 1906, $19.62. But there can be a policy pursued in regulating the home prices of iron which cannot be followed in the case of copper. Iron is protected; copper is not; and, therefore, if desired by the large manufacturers of iron to maintain a staple price, the very large margin of $11.20 per ton of steel and of $4 per ton of pig iron, which the duty gives them, may be used. In case of a low foreign price, a high domestic price can be sustained; or in case of high foreign price, the domestic price may be maintained at a given standard up to the limit of the duty. The McKinley bill struck off all duty on crude and refined copper, though retaining it on manufactured copper. Thus, the world's price regulates the American domestic price, and the copper producers have been saved from any temptation to form a copper trust, in order to derive the benefit of the duty. As to the regulation of price, considering our supreme position as producers, it may be more proper to say that we fix the price of the world. For a short period this year, the English price ruled slightly lower than the price demanded in the United States, and copper immediately commenced to flow in from abroad, although over any considerable period of time, say the past ten years, 54.5 per cent of our production has been exported, and we make 54.7 per cent of the world's total.

In spite of the active demand and the high price, last year's domestic production showed that there were only two years, since copper became a prominent article of domestic production, when copper production showed as slight a percentage of gain. A steadily progressive high percentage increase, however, cannot be maintained and should not be expected when the gross increase reaches certain limits. For instance, in 1896, when the percentage of increase over 1895 was 21 per cent, the actual increase was 81,168,640 lbs.; but during the last decade, the production has increased at such a rate that the 4.8 per cent increase of 1906 over 1905 represents an actual increase of 42,378,560 lbs. of copper—an increase of 137.4 per cent over the production of 1895, or 451.1 per cent over that of 1885.

Still, it is significant that this notable falling off in percentage increase should occur when the high price of copper may be supposed to have served as a stimulus to the utmost activity. The world's increase, as well as our own, showed a diminished percentage of increase—being 2.16 per cent instead of 6.16 per cent of the previous years.

*From the "Engineering Magazine."

To explain this anomaly, it must be borne in mind that as the average of the per cent of the ore treated was probably lower, more ore in proportion to the output of copper was probably mined. When copper is 20c., money can be made out of ore which is valueless with copper standing at 12c.; and, therefore, should the contents of the mines permit of selection, ore is utilized at one time which at another time is rejected. Moreover, the average percentage of ore of the great mines of the country is declining, and will continue to decline. Rich bodies of secondary deposits may be discovered in any deep mine, which may arrest the decline in its average yield, but the world's experience is not likely to be reversed in our favor—more especially as it coincides with our own—that the average yield of deep copper mines declines with depth; and as with declining yield generally occurs the increased cost of mining incident to greater depth, two factors concur to bring about the reduced production, which must occur sooner or later.

In comparing iron and copper mining, and the ease with which the varying demands of trade may be met by the producers, it must be remembered that two tons of average iron ore from the most prolific source now available—Lake Superior—will make one ton of metal; whereas from 33 to 75 tons (say an average of 50 tons) of copper ore must be mined to produce one ton of copper. A sudden increase in demand for the baser metal can be more readily met than when such a call is made for the rarer. The relative supply in nature may be gauged by the value on which the price of each is made, the value of iron being generally quoted by the ton, and of copper by the pound. Last year's production of iron was made from approximately 50,000,000 tons of ore. Our copper mines, to yield a production of 900,000,000 lbs., must have handled approximately 22,000,000 tons of ore, or nearly half the quantity of ore raised from our iron mines. The ore of iron, moreover, occurs in very large deposits, worked in some cases by steam shovels, whereas our copper comes from comparatively narrow veins or irregular masses.

Referring to the relative growth and decline of the three principal sources of the metal since the Western States began to grow into prominence, say from 1882, we find that at that date the Lakes supplied from ores of metallic copper 25,000 long tons of copper; Arizona, from oxidized ores, 8,000 long tons of copper; and Montana, from sulphide ores, 4,000 long tons. After that, the Lake production relatively declined. The Montana production continued to increase rapidly until 1887, when Montana took the first place with 35,000 tons, Lake Superior second place with 34,000, and Arizona third, with 8,000. This order was maintained until 1905, when Arizona attained the second rank.

The largest sources of new supply, which can be counted on with tolerable certainty, will be found in the low-grade ores of Utah and Nevada, where works on a very large scale are being planned or erected for their treatment.

The presence of small quantities of gold and silver in copper ores, now that the process of electrolytic copper refining permits these elements to be cheaply separated among the impurities, is putting within the range of profitable extraction ores of very low percentage in copper. When the Anaconda mine was first opened and its rich ores (and subsequently the mattes, made from them) were shipped to Europe for refining, the margin of gold and silver deducted from the ton of copper, before any allowance was made to the shipper, was $60. As this deduction was substantially the whole of the precious metals in the Butte copper, the company derived no benefit. Whatever margin there was in the $60 over and above the cost of separation went to the refiners.

Most of the rich argentiferous copper was then converted into bluestone. But since electrolysis has been applied to copper refining, and the process has been carried out on a large scale, the commercial charges for refining the copper and separating the precious metals have been reduced from $60 to $16, and as the value of the electrolytically refined copper is ordinarily about $10 per ton above that of furnace-refined copper, copper bars containing $6 in precious metals can be economically converted into electrolytic, and their gold and silver added to the world's wealth. If the copper bars contain the concentrated gold and silver of 30 tons of ore, the ore need contain only 20 cents of gold and silver per ton to make it profitable to submit the resulting copper to electrolysis. The amount thus extracted from domestic and foreign ores in the refineries of the United States is approximately: From Montana, $6,650,000; Arizona and Sonora, $2,105,000; Canada, $460,000; and other sources, $2,500,000—or over $11,000,000—most of which formerly entered the refined copper and was wasted.

While the presence of precious metals in high-grade ores redounds to the fortunate copper company which mines them, when ores of 2 per cent and under (like those of the Boundary district of British Columbia, or Bingham Canyon, in Utah, or of Ely County, in Nevada) are treated, the addition of $2 or $3 in gold and silver per ton may convert an unprofitable into a very profitable mineral. And from such ores will probably come much of the copper from our new mineral developments; for it is not probable that within the explored territory, many new large deposits will be discovered which are also of high grade, whereas lean ores in very large quantities are known to exist in many districts of the country. Apart from their contents in precious metals, better machinery and improved metallurgical methods permit of ores being treated economically today which would not have been classed as ore a few years ago; and today ores are rejected in developed mines which at no distant day may help us to maintain our position in the copper world.

To forecast the future of copper is impossible. It is safe to predict that, if no substitute is discovered, and the demand for the metal increases as it has done during the modern industrial era, the supply will fall short of the demand and the value of the metal will rise. The same is true of all the mineral products that are consumed in the arts. The experience of the last few years in the United States illustrates, however, the sensitive connection between demand and price.

While such spasmodic variations are transitory, there can be no doubt that if the demand grows, and no very important new discoveries are made, the metal will become scarcer and will command a higher price than the average price of the past. One consequence, which will also be a corrective, will be that the metal will cease to be used for purposes to which it is turned today, and for which a cheaper material can be discovered. For it is an invariable rule that when the metal has run up above a figure which deters purchasers from using it except for unavoidable purposes, the consumption drops off sharply, and a more normal value is restored.

A review of the world's mines would seem to indicate that the old mines are approaching exhaustion, that no new large deposits of rich ore, except possibly those of Tanganyika, are in sight; and, therefore, the trade must turn to deposits of lower grade than have heretofore been worked, if the demand continues as active as at present. And copper cannot be made as cheaply from mines of that class as from the mines we have been drawing upon so recklessly for a generation.

The next question bearing upon values is that of probable consumption. The three principal uses to which copper is now turned are: The manufacture of electrical machinery and the transmission of electricial current; in the composition of alloys, principally brass, for stationary engines, locomotives, railroad cars, automobiles, and for arms and ammunition, and in architecture; where it replaces iron and lead.

Glancing at the three sources of consumption, the draft on copper for telegraph wires, trolley lines, long-distance transmission, and other electrical purposes, is of comparatively recent date, and is doubtless very large—probably about one-third of the world's supply goes into this new industry; but comparatively little of it is actually consumed, though a great deal of it is through carelessness wasted during the installation of plants. The copper remains in service with little waste, or goes back to the refineries as scrap. But the demand for this purpose will not fall off. The urban and interurban mileage of trolley lines in the United States is between 30,000 and 40,000 miles. They have been built within very recent years, and new lines are reticulating the country. No substitute for copper in this class of roads has been suggested, for though aluminum may indifferently replace copper for current transmission, it cannot bear the wear and tear of the trolley. Gradually, also, the motor will displace the locomotive on all our present steam roads where traffic is dense; and though the third rail instead of the trolley wire will be used, the amount of copper which goes into the transmission, the generators, the motors, and all subsidiary appliances, will increase the proportionate demand for the metal by electricians.

The amount of copper which enters brass and other alloys it is difficult to determine. From information derived from several of our large railroad systems I would infer that about 5 grains of copper are consumed and actually go out of existence per car mile. This would represent about 5,000 tons of copper consumed by our railroads per annum for this purpose alone. Automobiles must make a new and very heavy call on copper, and the demand for stationary engines and steamboats is increasing with the growing industrial activity of the country. The quantity used up in war material and ammunition—during peace and war—is very great. In spite of probable fluctuations in the brass trade, there will be a large and satisfactory average growth.

But when we come to the third principal use for copper, that is, in the building and house-furnishing trade, we find it playing the part of an article of luxury. Our forefathers were satisfied with wrought-iron railings in their city houses, beautiful examples of which still exist in all the west-side streets of the old residential portion of New York City. Now we must have bronze balustrades in our palatial offices, hotels, and private buildings. Brass or bronze hinges or locks, gas fixtures, etc., appear in profusion in our houses and railroad cars, and brass and copper have driven out lead for roofing and plumbing. When copper is abundant and sells at a moderate price, it is the most desirable material for these purposes, but as it becomes rarer and dearer, substitutes for it will be used. As long, however, as money is forthcoming, the public taste for brass or bronze will be gratified, and probably more of the world's supply will go into architecture and house-furnishing than in any other use.

From the above review of the sources of supply and the sources of demand, it would seem that while there is no risk of copper becoming a rare metal in the near future, it will certainly have to be extracted from much leaner ores at an increased cost. Also while there is no reason to believe that its consumption in the arts will grow less, there are metals which can be substituted for it, should the popular taste or financial exigencies require.

CURRENT COMMENT

The essential distinction between a water-turbine and a wheel of the impulse type, beside the usual "low head" and "high head" differentiation, is that the former is a wheel in which the water enters around the entire circumference, instead of at one point, so that all the moving vanes are simultaneously acted upon by the dynamic pressure of the water, as it changes its direction and velocity.

Electromagnets are now used for lifting and handling large panes of glass. As glass is a non-magnetic material, a piece of sheet iron is placed under the glass and one or more electromagnets applied on the upper face. The electromagnets attract the sheet iron and thereby hold the glass suspended while moving. A patent on this method has been granted to E. I. Dodds, of Pullman, Ill.

Electric smelting of Norway's iron ores with graphite as a substitute for coal and coke may solve the problem of the utilization of these ores which, as a rule, contain too much titanium to be suitable for the usual furnaces. The country contains large deposits of impure graphite and abundant water power. Mr. Albert Hiorth, of Kristiania, has devised a furnace in which he smelted an iron-sand containing 13 per cent titanium oxide with graphite, containing 68 per cent carbon, lime being used as slogging material. He produced pig iron containing 0.01 per cent silica, and but a trace of titanium.

Electrical purification of water consists in the oxidation of the bacteria by means of ozone produced electrically without any injurious effect on the water. In the usual mechanical method the attempt is to filter out the bacteria, while in the chemical method free agents are added to destroy the organic matter, and these are liable to poison the water. In an apparatus recently designed by Leon Gerard, past president of the National Society of Electrical Engineers, of Belguim, 50 watt hours will produce enough ozone to purify 1,000 gallons of ordinary water. A frequency of 60 cycles at 11,000 volts gives the best results.

That the useful life of frosted incandescent lamps is only a little more than half the life of the corresponding plain bulb lamp is explained by Mr. Edward P. Hyde, of the Bureau of Standards, Washington, D. C., as due to the fact that although the filament in the frosted bulb emits the same total flux of light as that emitted by the filament in the plain bulb, the light is reflected through the glass of the frosted lamp several times, and the absorption of light by the carbon filament itself becomes so great in that case that the apparent intensity of the frosted lamp at any time during its life is less than that of the plain lamp, and the difference in intensity increases with the length of time a frosted lamp is used.

The United States consumes about 35 per cent of the world's total output of graphite and furnishes but 20 per cent of it. The amount imported into the United States in 1906, chiefly from Ceylon, was valued at $1,554,212, and the value of the domestic production was $340,239. The purest graphite is carbon with 0.05 to 0.20 per cent of hydrogen, but the commercial grades of crystalline graphite contain clayey impurities, even the best, such as some of that from Ceylon, comprising as high as 15 per cent of ash. The production of artificial graphite has steadily increased since 1897, the year of its introduction, and the quantity manufactured in 1906—5,074,757 pounds, valued at $337,204—is the largest yet reported. The use of this product is being rapidly extended, and it probably comes into competition with the natural graphite in many lines of manufacture.

While aluminum for overhead transmission lines has been employed to some extent in this country, its use in underground circuits has been prohibitive because of the comparatively high cost of aluminum, the impurities which reduce the electrical conductivity, and the difficulty of satisfactory joints. According to the "Mechanical Engineer," these drawbacks have been successfully overcome by an English firm which supplies insulated aluminum cables of a conductivity equal to copper at a price which shows a considerable saving when compared with the price of copper conductors, particularly when as high as before the present slump. The great drawback to the use of aluminum for electrical purposes in the past has been the difficulty of obtaining it sufficiently pure. At the present time aluminum may be obtained with a purity of 99.9 per cent, the average purity of commercial aluminum being 99.6 per cent.

Among the railroads in the West now treating timber is the Santa Fe, which has a large creosoting plant at Somerville, Tex., with a capacity of 15,000 ties a day. The Santa Fe is also building a new plant at Albuquerque, N. M., where a crude oil will be substituted for creosote. In addition to treating the timber, the Santa Fe is planting eucalyptus trees on a 9000-acre tract near San Diego, Cal. The timber manager of this company has been sent to Australia to look up new species of trees. The Southern Pacific operates two plants at West Oakland, Cal., one at Houston, Tex., and another at Los Angeles, Cal. Red fir and pine are being treated. In the Northwest the Oregon Railway & Navigation Company maintains a zinc chloride and creosoting plant at Wyeth, Ore., while commericial plants are located on the Puget Sound. Among the more important new treating plants in course of erection are two by the Northern Pacific, one very large plant by the Burlington at Galesburg, Ill., four by the Rock Island and two or three by the Illinois Central.

Artificial diamonds as made by Moissan were scarcely visible to the eye, and the process was so expensive that it was not practical. Moissan produced his diamond dust by means of tremendous heat and sudden cooling, and immense pressure. M. Aristide Charette, a French chemist who has shown stones of a fairly good size to the members of the Academy of Science at their last meeting, states that they were produced by causing a very feeble electric current to pass through liquid bisulphide of carbon, mixed wtth some iron, and hermetically sealed in a vacuum tube. In this way the iron was transformed into sulphide, and the carbon crystallised slowly on the sides of the glass tube, owing to the fact that it was unable to turn into carbon oxide or carbonic acid, for the want of the oxygen in the air. M. Charette presented some tubes with the crystals inside to the members of the Academy, and they were found to have apparently all the hardness, lustre, and other qualities of the purest natural gems, as far as could be judged from their mere aspect. In order to examine the matter thoroughly, the Academy has appointed two of its members, M. le Chatelier and M. Lacroix, to examine the stones from a chemical and mineralogical point of view.

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EDITORIAL.

EFFICIENCY OF PUMPING PLANTS.

The article published in this week's issue of the "Journal," giving the results of complete tests upon the 100 horsepower induction motor three-stage centrifugal pumping plant of the San Pablo Quarry Company, near Richmond, Cal., is of more than ordinary interest to engineers. Three-phase, 10,500-volt, sixty-cycle current is delivered to the pumping plant and the water is first lifted twelve feet and then forced against an additional head of about 185 feet, making a total lift of about 200 feet.

The efficiency of every transformation of power was determined with the ultimate result that the ratio of the energy delivered from the high tension lines to the energy of the water at the nozzle was found, including losses in electrical conductors, pump and all electrical apparatus.

The well-known fact that the efficiency of a centrifugal pump depends to a great degree upon the head when the speed is maintained constant is shown in the results. It is always desirable to modify the speed conditions of such a pump to conform to changes in the head of water, but there are in many cases, as in the one under consideration, circumstances which make a change in speed impractical notwithstanding the seemingly low plant efficiency which results. In this plant the electrical apparatus gives satisfactory operating results not only as to reliability but also in efficiency. The unfavorable conditions under which the centrifugal pump is operated are responsible for the low plant efficiency. However, to supply the proper variable speed to the pump would necessarily reduce the efficiency of the electrical machinery and especially that of the motor. Additional controlling devices would also be required and the ultimate result would not in all probability give materially greater plant efficiency.

The plan used in testing the induction motors is the well-known Heyland method, and as all details are given and the principles involved are fully explained, the article is worthy of careful reading, not only as probably average results under working conditions are obtained, but as a very valuable and simple process is outlined for making efficiency tests upon induction motors that are practically continuously in service.

In the same way the hydraulic tests have an additional value aside from the actual results found in this particular plant. The use of a pressure gauge at the nozzle and a Venturi meter gives results which are readily obtained and are quite reliable providing the value of the efflux coefficient is correctly assumed.

Such complete and detailed tests as these are often of more value in giving intermediate results and principles and methods of testing than in obtaining data for plant efficiencies which will be found to obtain in other plants of different design or which are operated under conditions of a different character.

TRADE CATALOGUES.

Bulletin No. 9 from the Century Electric Company, of St. Louis, Mo., illustrating and describing Century single phase self-starting alternating current motors, is one of the best expository catalogues that has reached this office. Rare good judgment is indicated, not only in the text but also in the arrangement. Its matter is invaluable to any one interested in single phase motors, to which the Century Electric Company confines its efforts exclusively.

Fort Wayne Electric Works, of Fort Wayne, Indiana, send Bulletin 1097, illustrating and describing Portable Wattmeter Calibrators, type K M-1, which provides a quick method of calibrating an instrument measuring variable load without the use of a stop watch. Bulletin No. 1099 shows the good points of Enclosed Direct Current Multiple Arc Lamps for either 110 or 220 volts for interior illumination. In Bulletin No. 1101 is explained the Multiple System of Street Arc Lighting with alternating current. The general plan of station and line equipment is outlined, and the advantages of a system that is simple, flexible and safe are detailed.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces an examination on December 4-5, 1907, to secure eligibles from which to make certification to fill three vacancies in the position of miscellaneous computer, Naval Observatory, Washington, D. C. The Department states that miscellaneous computers are paid by the hour, and earn from $1,000 to $1,200 per annum. Promotions are made from this grade, without further examination, to the grade of assistant, at $1,200 per annum, as vacancies occur.

The United States Civil Service Commission announces an examination on November 27, 1907, to secure eligibles from which to make certification to fill two vacancies in the position of draughtsman-cartographer in the Philippine Service, at $1,800 per annum each, and vacancies requiring similar qualifications as they may occur in the Philippine Service. The duties of one of these positions will be the systematic arrangement of all the cartographic material in the hands of the Philippine Government so as to render useful and accessible; those of the other will be the compilation and construction of maps from data of unequal value. Applicants who possess a technical training, who have had a fair amount of excellent experience in surveying work and plotting, and who are passable draftsmen will be eligible, but preference, other things being equal, will be given to those who have had experience in cartographic work. Men only will be admitted to this examination. Competitors will not be assembled for this examination, they being rated on the training and experience as shown in the application.

The United States Civil Service Commission announces an examination on December 11, 1907, to secure eligibles from which to make certification to fill a vacancy in the position of nautical expert, at $1,000 per annum, in the Hydrographic Office of the Navy Department, and vacancies requiring similar qualifications as they may occur in that office. As the Commission has experienced considerable difficulty in securing eligibles for this position, qualified persons are urged to enter this examination. At the request of the Department, applications will not be accepted from persons who have not attended for at least two years a nautical school of no less a grade than the schools maintained upon the scholarships of the States of Massachusetts, New York, and Pennsylvania, or who have not served for at least three years on board vessels navigating either the Great Lakes or the ocean.

The United States Civil Service Commission announces an examination on December 4-5, 1907, to secure eligibles from which to make certification to fill 10 vacancies in the position of civil engineer in the Philippine Service, at $1,400 per annum each, and vacancies requiring similar qualifications as they may occur in that service. There are, however, similar positions in that service paying higher salaries, and it is desired to secure from this examination eligibles who are qualified to fill the higher salaried positions in the event that vacancies therein occur. As but very few persons applied for the examination held for this position on October 16, and as the Commission has experienced difficulty in securing sufficient eligibles to meet the needs of the service, qualified persons are urged to enter this examination. Appointees are allowed field expenses when absent on duty from their permanent station.

PERSONAL.

Harry Kirkland, representing the National Metal Moulding Co., of Pittsburg, has been in San Francisco during the past week.

H. F. Reynolds, formerly of Marion, Indiana, has opened an office as electrical engineer and contractor at 656 Empire Building, Seattle, Wash.

G. A. Schneider, recently with the California Electric Company, at Los Angeles, has been placed in charge of the power apparatus department of the California Electrical Works of San Francisco.

C. W. Whitney has resigned as manager of the publicity department of Abner Doble Co., and accepted a position as purchasing agent with Ransome Concrete Co., of California, with offices in the Crocker Building, San Francisco.

H. L. Hibbard has resigned as electrical expert to the Bureau of Construction and Repair, U. S. Navy Department, to enter the employ of the Cutler-Hammer Mfg. Co., of Milwaukee, makers of electric controlling devices.

BOOKS RECEIVED.

The Convention Issue of the Transactions of the Illuminating Engineering Society, Vol. II, No. 7, in addition to the usual society notes, contains the following papers:

Presidential address: "The Concepts and Terminology of Illuminating Engineering," by Clayton H. Sharp; "Primary, Secondary and Working Standards of Light," by Edward P. Hyde; "Illuminating Engineering and Central Station Practice," by Leon H. Scherck; "Illumination of the Engineering Societies Building, New York," by C. E. Knox; "The Present Status of Candle-Power Standards for Gas," by C. H. Stone; "The Inverted Gas Light," by T. J. Litle, Jr.; "Acetylene," by A. Cressy Morrison; "Acetylene Lighting," by Nelson Goodyear; "A New Comparison Photometer," by Dr. Chas. H. Williams; "Illumination Photometers and Their Use," by Preston H. Millar; "A Graphic Illumination Chart," by Albert F. Parks; "The Elements of Inefficiency in Diffused Lighting Systems," by Preston S. Millar; "Electric Light as Related to Architecture," by C. Howard Walker; "The Illumination of the Building of the Edison Electric Illuminating Company, of Boston," by Louis Bell, L. B. Marks, W. D'A. Ryan; "What is Street Lighting?" by William H. Blood; "A Check on the Reliability of Photometric Curves," by J. S. Codman; "Coefficients of Diffuse Reflectors," by Dr. Louis Bell; "Metallic Flame Arc Lamp," by C. E. Stephens; "New Lights and New Illuminants from the Central Station's Point of View," by R. S. Hale.

TRADE CATALOGUES.

A handsomely illustrated catalogue from the Welsbach Company is devoted to the Inverted "Reflex" Gas Lamp and Glassware.

Chase-Shawmut Company, of Newburyport, Mass., have recently issued bulletin and price list No. 101, descriptive of stage lighting appliances. It is convenient in form and clear in its information, which should make it of distinct service to all interested in these matters. It is a continuation of a series of bulletins this company is now getting out, bulletin No. 100 having recently been issued covering National Electrical Code Fuses, Cutouts and Fittings, Railway Cutout Boxes, Pocket Test Lamps, etc.

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	INTEREST	MISCELLANEOUS BONDS.	NOV. 7		NOV. 8		NOV. 9		NOV. 11		NOV. 12		NOV. 13	
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%	.....	80	.....	80	.....	80	.....	80	.....	80	.....	80
2,250,000	M & S	Bay Counties Power Co. 5%	92	.....	92	.....	92	.....	92	.....	92	.....	92	.....
1,000,000	F & A	Cal. Central Gas & El. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%	.....	70	.....	70	68¾	70	.....	70	.....	70	69	.....
900,000	J & J	California St. Cable Co. 5%	.....	102½	.....	102½	.....	102½	.....	102½	.....	102½	.....	102½
2,000,000	J & J	Contra Costa Water Co. 5%	.....	100	.....	100½	.....	100½	.....	100½	.....	100½	.....	100½
1,000,000	J & J	do do Gen. Mtg. 5%	.....	90	.....	90	.....	90	.....	90	.....	90	.....	90
623,000	F M A N	Edison Light & Power 6%	109	.....	109	.....	109	.....	109	.....	109	.....	109	.....
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
671,000	A & O	Geary St. Ry. 5%	50	80	50	80	50	80	50	80	50	80	50	80
610,000	M & N	Honolulu R. T. & L. Co. 6%	100	105	100	105	100	105	100	105	100	105	100	105
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
500,000	J & J	Los Angeles Elec. Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
5,000,000	A & O	Los Angeles Ry. 5%	.....	107½	.....	107½	.....	107½	.....	107½	.....	107½	.....	107½
1,000,000	A & O	Los Angele Lighting Gd. 5%	.....	102	.....	101½	.....	101½	.....	101½	.....	101½	.....	101¼
1,500,000	A & O	Los Angeles Pac. R. R., 1st Con. Mtg. 5%	.....	101	.....	101	.....	101	.....	101	.....	101	.....	101
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%	.....	98	.....	98	.....	98	.....	98	.....	98	.....	98
3,000,000	J & J	Market Street Cab'e 6%	.....	106	.....	106	.....	106	.....	106	.....	106	.....	106
5,141,000	M & S	do Ry., 1st Cons. Mtg. 5%	.....	102½	.....	101	.....	101	.....	101	.....	101	.....	101
100,000	A & O	Mill Valley & Mt Tamalpais S.Ry.5%	100	.....	100	.....	100	.....	100	.....	100	.....	100	.....
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	108	110	.....	109	.....	109	108¼	108½	108	108½	.....	108½
1,498,000	J & J	North Pacific Coast R. R. 5%	99¾	.....	99¾	.....	99¾	.....	99½	.....	99	101	99	101
1,074,000	J & D	Northern Cal. Railway 5%	105	.....	105	.....	105	.....	105	.....	105	.....	105	.....
980,000	J & D	Northern Cal. Power Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
6,000,000	A & O	Northern Electric Co. 5%	.....	99	.....	99	.....	99	.....	99	.....	99	.....	99
1,000,000	M & S	Oakland Gas Light and H. 5%	101½	105	101½	105	101½	105	101½	105	101½	105	101½	105
1,374,000	J & J	Oakland Transit Co. 6%	108¾	110	.....	110	.....	110	.....	110	.....	110	.....	110
1,600,000	J & J	Oakland Transit 5%	101½	.....	101½	.....	101½	.....	101½	.....	101½	.....	101½	.....
1,326,000	J & J	Oakland Transit Con. 5%	99	100	99	100	99	100	.....	99	.....	100	.....	100
7,000,000	J & J	Oakland Traction Con. 5%	.....	98	.....	98	.....	98	.....	98	.....	98	.....	98
1,500,000	J & J	Oakland Water Co. gtd. 5%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
2,000,000	A & O	Omnibus Cable Ry. 6%	.....	111	.....	111	.....	111	.....	111	.....	111	.....	111
1,149,000	S D M J	Pacific Gas Imp. 4%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
8,494,000	J & J	Pacific Electric Ry. Co. 5%	.....	101½	.....	101½	.....	101½	.....	101½	.....	101½	.....	101½
4,491,000	J & J	Pacific Light & Power Co. 5%	.....	97½	.....	97½	.....	97½	.....	97½	.....	97½	.....	97½
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%	.....	102½	.....	102½	.....	102½	.....	.....	.....	.....	.....	.....
350,000	J & J	Park & Cliff House Ry. 6%	.....	104	.....	104	.....	104	.....	104	.....	104	.....	104
250,000	J & J	Park & Ocean R. R. 6%	.....	104	.....	104	.....	104	.....	104	.....	104	.....	104
700,000	M & S	Powell Street Railway 6%	.....	106½	.....	106½	.....	106½	.....	106½	.....	106½	.....	106½
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%	.....	94½	90	93½	90¾	93	90¾	93	90¾	93	90¾	93
6,000,000	A & O	S. F. & S. J. Valley Ry. 5%	.....	110½	.....	110½	.....	110½	.....	110½	.....	110½	.....	110
3,000,000	J & J	S. F., Oak. & San Jose Ry. 5%	.....	105	.....	.....	.....	.....	.....	102½	.....	102½	.....	101½
1,500,000	J & J	do do 2d Mtg. 5%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4½%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
642,000	A & O	Sierra Ry. of Cal. 6%	102	.....	.....	105	.....	105	.....	105	.....	105	.....	105
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	101	.....	101	.....	101	.....	101	.....	100¾	.....	100¾	.....
4,000,000	J & J	do do do (1910)	102	.....	102	.....	102	.....	.....	.....	.....	.....	.....	.....
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)	102	.....	102	.....	102	.....	101¾	.....	101¾	.....	101¾	.....
4,127,500	M & N	S. P. R. R. of Cal., 1st c. gtd. 5%	105	.....	105	.....	105	.....	105	.....	105	.....	105	.....
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	.....	122¼	.....	122¼	.....	122¼	.....	122¼	.....	122¼	.....	122¼
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	83¾	.....	83¾	.....	84	84½	84¼	85	84¼	85	84¾	86
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%	.....	85	.....	85	.....	85	.....	.....	.....	.....	.....	.....
300,000	M & S	Stockton Gas & Elec. Co. 6%	.....	105	.....	105	.....	105	.....	105	.....	105	.....	105
2,000,000	J & J	United Gas & Elec. Co. 5%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20,000,000	A & O	United R. R. of S. F. 4%	61¾	64	61¾	62½	61¾	.....	.....	62½	.....	62½	.....	62½
2,500,000	M & N	Valleys Counties Power Co. 5%	.....	99½	.....	99½	.....	99½	.....	99½	.....	99½	.....	92½
		Water Stocks.												
.....	.....	Contra Costa	.....	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6,000	Quarterly	Marin County	45	.....	45	.....	45	.....	45	.....	45	.....	45	.....
280,000	.....	Spring Valley Water Co	19¾	19⅞	19⅞	20½	19⅞	20¼	20	.....	20	20¼	20	.....
		Gas and Electric Stocks.												
37,500	.....	Martel Power Co	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9,340	.....	Mutual Electric Light Co. (Ctfs.)	4⅝	.....	4⅝	.....	4⅝	.....	4⅝	.....	4⅝	.....	4⅝	.....
37,336	.....	do (Extended Ctfs.)	9	9¾	9	9¾	9	9¾	9	9¾	9	9¾	9	9¾
40,000	Monthly	Pacific Lighting Co	65	.....	65	.....	65	.....	65	.....	65	.....	65	.....
12,000	.....	Stockton Gas & Elec. Co	52	.....	52	.....	52	.....	52	.....	52	.....	52	.....
		Street Railroad Stocks.												
10,000	.....	California	.....	135	.....	135	.....	135	.....	135	.....	135	.....	135
10,000	.....	Geary	.....	35	.....	35	.....	35	.....	35	.....	35	.....	35
10,000	.....	Presidio	.....	25	.....	25	.....	25	.....	25	.....	25	.....	25
	Semi-an.	Associated Oil Co	23½	.....	23½	.....	23⅜	.....	23½	.....	23¼	24½	23¼	.....
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry	110	.....	110	.....	110	.....	110	.....	110	.....	110	.....
180,000	Quarterly	Pac. Tel. & Tel. Co. (Pfd.)	74¾	.....	74¾	.....	.....	78	.....	79	.....	75	.....	75
180,000	.....	Pac. Tel. & Tel. Co. (Common)	.....	11	.....	11	.....	10½	.....	11	.....	11	.....	11

Unlisted Securities

750,000	A & O	Bay Counties Power Co. 6%	97	.....	97	.....	97	.....	97	.....	97	.....	97	.....
745,000	M & S	Blue Lakes Water Co. 6%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2,000,000	A & O	California Northwestern Ry. 5%	.....	106	.....	106	.....	106	.....	106	.....	106	.....	106
160,000	J A J O	Marin County Water 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
600,000	J & J	Risdon Iron Works 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
500,000	M & S	S. F. Dry Dock 5%	100	109	100	109	100	109	100	109	100	109	100	109
8,000,000	M & N	S. P. Gas & Electric 4½%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
3,926,000	J & J	S. F. & North Pacific Ry. 5%	.....	105	.....	105	99	.....	99	.....	98	.....	98	.....
5,500,000	J & J	South Pacific Coast Ry. 4%	.....	90	.....	90	.....	90	.....	90	.....	90	.....	90
.....	.....	Standard Electric Co. 5%	.....	85	.....	85	.....	85	.....	85	.....	85	.....	85
.....	.....	do do Gtd. 5%	.....	85	.....	85	.....	85	.....	85	.....	85	.....	85
750,000	J & J	Sunset Tel. & Tel. Co. 6%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%	.....	103½	.....	103½	.....	103½	.....	103½	.....	103½	.....	103½
1,000,000	M & N	Sutter Street Railway 5%	.....	103	.....	103	.....	103	.....	103	.....	103	.....	103
		Stocks.												
50,000	Monthly	Gas Consumers' Association	.....	17½	.....	17½	.....	17½	.....	17½	.....	17½	.....	20
100,000	Monthly	Northern Cal. Power Co	.....	22	.....	22	.....	22	.....	22	.....	22	.....	22
.....	.....	Pac. Gas & Elec. (Pfd.)	.....	45	.....	45	.....	45	.....	45	.....	45	.....	45
.....	.....	Santa Cruz Port. Cement	..	47½	.....	47½	.....	47½	.....	47½	.....	47½	.....	47½
.....	.....	Standard Port. Cement (New)	.....	45	.....	45	.....	45	.....	45	.....	45	.....	45
50,000	Monthly	Truckee Electric Co	13½	.....	13½	.....	13½	.....	13½	.....	13½	.....	13½	.....

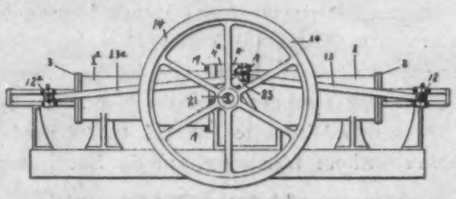
PATENTS

Electric, Gas and Water.

Specially reported for the Journal of Electricity, Power and Gas.

DOUBLE TWO-CYCLE ENGINE. 869,503. William L. Morrow, Stockton, Cal.

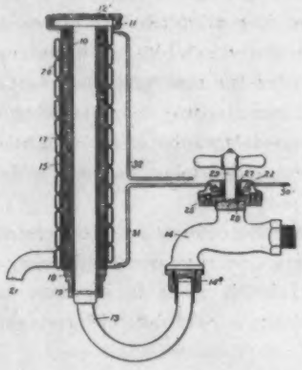
In a gas engine, two cylinders disposed in longitudinal alignment and provided with closure heads at the outer ends, a dividing member between the cylinders and formed in two parts having half bearings in their adjacent faces, means for connecting two-part dividing member between said cylinders, a shaft journaled in bearings and with cranks



at the outer ends, pistons operating respectively in cylinders, piston rods connected to pistons and extending through the closure heads of the cylinders, cross heads connected to the free ends of piston rods, and coupling rods between cross heads and cranks.

ELECTRIC HEATER. 869,464. George E. Stevens, Lynn, Mass., assignor to General Electric Company.

In a fluid heater, the combination of a resistance unit



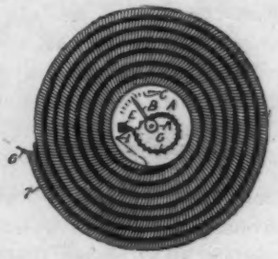
having a central opening, fluid conducting tubes extending lengthwise of unit through opening and over the outer walls of the unit, and suitable inlet and outlet openings and end connections.

HYDRO-CARBON ENGINE. 864,844. Edmund Hudson, Templeton, Mass.

In combination in a hydro-carbon motor having a combustion chamber and an air compression chamber, an air passage intermediate to the air compression chamber and combustion chamber, a piston arranged to control the passage of air intermediate to chambers, a crank shaft, a hydrocarbon pump, having means for constantly maintaining an oil pressure in advance of the pump piston and means intermediate the crank shaft and pump for operating the pump piston, an injection nozzle operatively arranged with reference to the pump and combustion chamber, and means for varying the amount of hydrocarbon passed through injection nozzle and the instant of its passage.

ELECTRIC HEATING FABRIC. 869,460. Walter Richmond, Memphis, Tenn.

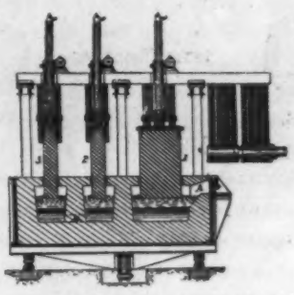
The combination with an electric heating mat or the like composed of a high resistance conductor wound about a core, of an expansible controller mounted upon the core, a high resistance conductor in circuit with the expansible



controller and with the conductor which is wound about the core, and means arranged upon the core and in circuit with the expansible controller for adjusting the tension of the same, controller being arranged when expanded to break its contact with the member.

ELECTRIC FURNACE. 869,432. Gustave Gin, Paris, France.

An electric furnace comprising three communicating reaction chambers, and provided with outlet apertures for chambers, one of chambers having an aperture upon the opposite side of furnace from the apertures of the opposite



end chamber, and means to tilt the furnace to either side of its normal longitudinal axis to discharge material from chambers, the means of communication between each end chamber and the middle chamber being upon the opposite side of furnace from the outlet aperture of the associated end chamber.

ARC-LAMP ELECTRODE. 869,300. Richard Fleming, Lynn, Mass., assignor to General Electric Company.

An arc lamp electrode consisting of an iron tube filled

with particles of iron and having means provided at one end of the tube for retaining the iron particles in the tube and increasing the conductivity of the electrode at that point.

INDUSTRIAL

WIRE JOINT.

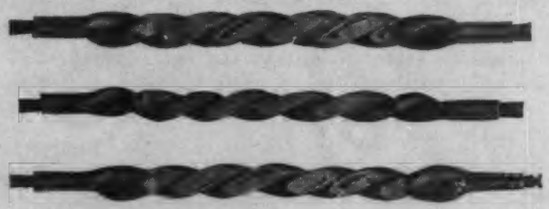
Frank B. Cook has perfected a "Wire Joint" for splicing both iron and copper wires which is mechanically and electrically perfect. He claims that he has demonstrated this fact to the satisfaction of some of the largest users in the country as well as many noted electrical engineers.

The construction of the sleeve or joint is, in itself, a simple device to look at, but its success is due to its peculiar design and care in its manufacture.

Referring to Fig. 1, it will be noted that one side is flat, and the other is formed to fit the wires. In twisting, the flat side is drawn up into the recess between the wires and meets the upper or formed side, stretching the metal around the wires so tight as to completely close up any space and make a perfect cold weld between the metal in the joint and the wire. It is only necessary to use the ordinary splicing tools, and the mere act of twisting the joint makes a connection that is air and moisture proof—the ideal electrical splice.

The early method of making a splice was to twist the wires together and solder the joint. After a time, this method was replaced to a certain extent by inserting the wire in a double tube sleeve and twisting the sleeve and wires together. This later method gave moderate satisfaction in splicing copper wires, but in splicing iron wire many of the large users decided to return to the old manner of twisting and soldering, even though more expensive than the sleeve, their reason being that they could not depend upon the joint made with the new sleeve. Moisture penetrated, setting up corrosion, causing high resistance, and the joint thus made was weak. Having all these faults in mind, Mr. Cook so constructed his sleeve as to retain the strength and other desirable features of the twisted and soldered splice, and produce a sleeve which has maximum strength and efficiency combined with minimum labor in application. A comparison of the efficiency of this joint as compared with other types is best shown by referring to Fig. 2, in which "B" is a Cook No. 10 joint with one No. 10 and one No. 12 wire, and "A" and "C" are other No. 10 joints made up under the same conditions. This illustration is a reproduction of a photograph which has not been retouched. The upper portion of each sleeve or joint was filed away to show the interior of the joint. This illustration also shows that the Cook sleeve may be used as a combination joint with perfect success, which feature is of considerable value, as it means less variety of sizes in stock for the consumer.

The strength of the Cook joint has been thoroughly demonstrated, but some facts may be of interest: The joint **is positively** stronger than the wire. It will stand several twists in addition to the 3½ twists used in common practice without fracturing, and in fact it can almost



be tied into a knot.

Mr. Cook also announces that the Western Union Telegraph Company has adopted his Joint after exhaustive tests, and incidentally exhibits an initial order for 500,000, also a recent order for the Australian Government, and an "eye opener" from Japan, demonstrating that the Cook Joint is used on telegraph, electric light and power circuits with perfect satisfaction, as well as in telephone construction.

Mr. Cook has an interesting little circular on this joint which he will mail to any interested party upon request.

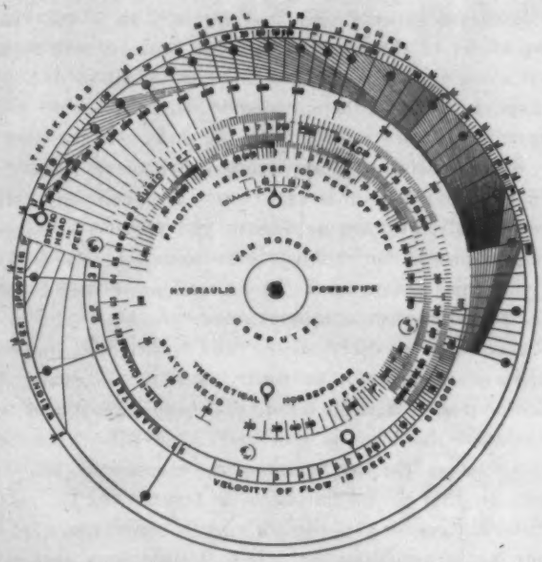
The Cook Joint is made in all sizes, and the name is Cook Self-Welding Wire Joint—memorize it, it's worth it.

The world's rubber production for the year ending June 30th, 1907, amounted to 74,023 tons, as compared with 67,999 tons in the preceding harvest year. The world's consumption is stated to have been 68,173 tons, as against 62,574 tons in 1905-6, and the stocks existing on June 30th, 1907, are put at 6,464 tons, as contrasted with 5,352 tons at the corresponding period of 1906. The arrivals of all qualities of rubber in Europe, which are included in the foregoing totals, reached 36,547 tons in the past year, as compared with 37,486 tons in 1905-6, and the arrivals in the United States were 32,730 tons, as against 25,596 tons respectively. These figures show remarkable progress for the latter country simultaneously with a decline in the shipments received in Europe. The past two years represent an unmistakable downward movement in the prices of fine Para, which received the highest rate in the year 1904-5.

A RAPID CALCULATOR.

The accompanying illustration shows a new device for the rapid calculation of the various functions and dimensions of hydraulic pipe-lines. It was designed by Rudolph W. Van Norden, of San Francisco.

There is probably more uncertainty as to the exact behavior of water, with the accompanying losses by friction, change in velocity, direction, etc., than in any other branch of practical engineering, and many formulas have been worked out, none of them, however, fulfilling all the conditions required. The development of power for all purposes from high waterfalls, entailing great pressures, has enor-



mously enlarged the use of riveted sheet iron and steel pipe, especially on the Pacific Coast.

The formula on which the working of this computer is based was developed as the result of a large number of tests on pipes, varying greatly not only in the pressure applied but in size and length. It is accurate for all ordinary conditions.

There are two movable dials, a movable sector, and a stationary dial. With these, eight factors are determined, provided any two are known and one assumed. These factors are: Diameter; thickness of metal; weight per foot of length; static head; quantity of flow, in second-feet; friction head; velocity of flow; theoretical horsepower of the water.

The scale of flow, in cubic feet per second, is on the larger dial, 6 inches in diameter, arranged to coincide with that of the friction head, on the small dial, 5 inches in diameter, the latter being drawn to one-half the logarithmic unit dimension of the former. When the initial points of both scales are placed so as to coincide, the numbers on the lesser scale are the squares of the corresponding numbers on the other scale. Through a window in the small dial, under the friction head scale, is shown a scale of the diameter, drawn on the large dial. These three scales are proportioned so as to represent graphically the friction head formula used.

A scale showing the static head is also drawn on the small dial, and when placed in contact with the proper value on the flow scale shows the theoretical horsepower through a second window in the small dial (not shown in the cut), by a scale drawn on the large dial. This is a simple multiplication in the first power, arranged with a constant.

On the stationary dial, in contact with the scale of flow, is a second scale of the diameter and also one giving the velocity of flow, this last value varying directly as the flow and inversely as the square of the diameter.

On the outer circle of the stationary dial are two concentric scales, one showing the proper thickness of metal, using a factor of safety of 4½ and a tensile strength of 50,000 lb., and the other the weight per foot of the completed pipe at the thickness determined. The two scales are operated by a sector having a curved edge, based on the graphical representation of the static head, various values of which are also shown on a logarithmic scale. The contact, of a value of the static head, with one of diameter, determines the thickness. A series of curved lines, joining points of similar weight of the various sizes of pipe, terminates in a scale of weights; the curved line denoting the weight should be selected as the one coinciding with the intersection of the curved edge of the sector and diameter.

The scale of friction head is carried to 1,000 feet to allow for calculations for the flow of water from pumps. The pressure required to force a given quantity of water through a given length and size of pipe can be instantly determined by finding the friction head for the total length and adding to it the static head on the pipe. This method does not, however, provide for sharp bends or entrance friction.

Long cast-iron and wood-stave pipes may be calculated for flow, diameter, velocity, and friction head. In the former, however, the values of friction head, where the pipe has a diameter less than 16 inches, are less than those given by the computer, or in other words, the quantity of flow for a given friction loss is greater. The proper constants are, however, tabulated so that the calculations for the smaller sizes may be made. The friction head of wood-stave pipe is from 50 to 70 per cent of the values given, depending on whether the pipe be old or new, but the use of these constants for wood pipe will give results somewhat less than those derived by Kutter's formula, when n is taken as 0.010 for pipes from 12 inches up, and this difference increases as the diameter increases, until for 24 inches it amounts to 35 per cent and for 48 inches to 50 per cent of the higher value.

This method, therefore, computes the flow for large wood pipes greater than that determined by the Kutter formula method for a given friction loss.

A page of directions accompanies the instrument, clearly showing the various operations, and with a little practice the operation will be found to be as simple and as accurate as the slide rule. The calculator is bound in a neat board cover. The dials are made of the best quality of bristol board, reinforced on the back with muslin, while the surface is finished with a waterproof varnish, which can be washed if soiled.

In the accompanying cut the computer is set to work the following problem: Given a flow of 11 cubic feet

per second, head of 500 feet, and assume a diameter of 16 inches.

The line showing 500 feet on the sector is placed to coincide with that showing a diameter of 16 inches on the stationary dial. The large dial is then revolved so that the number 11 on the flow scale will also coincide. Place the pointer for diameter at the window in the small dial at 16 inches of the second diameter scale. In contact with the line of flow, head, and diameter is the friction head, which in this case is 1.6 feet per 100 feet of pipe. The pointer at the lower side of the large dial shows the velocity of flow, which is 8 feet per second. The pointer on the sector gives the thickness of metal, which is 5-32 inch. Following out the curved line which coincides with the intersection of the diameter line and the edge of the sector, gives the weight per foot of the finished pipe as 30 pounds.

To get the theoretical horsepower in the water, the small dial must be revolved until the number in the second, head in feet scale, which in this case is 500, coincides with the number 11 in the flow scale. Through the second window in the small dial may then be read the answer, 640 horsepower.

It will be readily seen that any other two quantities might have been the given ones, and that any third quantity may be assumed.

Among the large industrial corporations of the country which the recent financial crisis did not affect adversely, Allis-Chalmers Company of Milwaukee, is especially prominent, for the reason that its name has previously been coupled with various sinister rumors circulated largely for speculative effect. And the fact that it stands unshaken, despite the tremendous load of orders being executed in its shops and the necessity for large current funds which such a condition of prosperity inevitably entails, may be attributed in no uncertain manner to the wise foresight of its present management, which, perceiving the trend of events, made provision for it far enough in advance to effectually safeguard the company's interests.

The annual meeting of the stockholders held in Jersey City, October 24th, at which the policy of President W. H. Whiteside was fully indorsed, brought to light the present strong position of this company, not only with reference to work actually completed or on order, but also from the standpoint of close alliance with many of the most powerful financial interests on this side of the Atlantic.

Among the present directors are Judge Elbert H. Gary, chairman, Board of Directors, United States Steel Corporation, who is also chairman of Allis-Chalmers Company's Board of Directors; Charles Mac Veagh, Edmund C. Converse, and Alexander F. Banks, of the United States Steel Corporation, the former being general counsel, and the latter two directors of that corporation, and also prominent in leading financial institutions of New York and Chicago; Cornelius Vanderbilt, whose name stands for the vast properties controlled by his family; William V. Kelley, president American Steel Foundries; Herman Falk, president Falk Company, of Milwaukee; Edward D. Adams, and William A. Read, well known Eastern capitalists; George Bullock and Joseph Neave, who control important business interests of New York and Cincinnati; Mark T. Cox, who, as a banker, has long been identified with leading industrial and railroad properties of the Central and New England States; Max Pam, a prominent attorney and financier of Chicago; Charles Allis, of Milwaukee, and Lahman F. Bower, and Henry Woodland, vice-presidents of the company, who, with President Whiteside, also a director, represent the company's home interests.

Walter H. Whiteside was unanimously re-elected president, thus insuring a continuation of the business-like policy which has characterized the operations of the company since he became its executive head. In the future, President Whiteside, with Chairman Gary, will be in full charge of the affairs of the company, and its business will be continued along lines already laid down by them.

Reports made at the meeting show that the net profits in April were more than $37,000; for May, $69,000, and for June, $93,000, with a total during the quarter from April to June 1, of more than $200,000. The company netted $81,000 in July, $101,000 in August, and $106,000 in September. The profits for the half year netted nearly $500,000. The company's orders on its books total more than $15,000,000, and the business continues good.

These figures show steady and substantial improvement since April, 1907, at which time the company first began to receive benefits from the newly developed lines of machinery built in its enlarged West Allis Plant, provided therefor; the net earning in excess of all fixed charges for that period having been $489,267.86.

Profits have nearly tripled in the short space of six months, notwithstanding the fact that conditions during the past year have been generally unfavorable, due to a combination of circumstances beyond the company's control, including the general strike of molders throughout the country; the failure of contractors to complete buildings on time, the delayed delivery of equipment for the new shops, and the large expense contingent upon the organization of the new plant and necessary development of new lines of manufacture. On the other hand, such improvements in methods have been effected that with an increase to over 9,000 in the number of workmen, being more than 38 per cent for the year, the rate of production per employe per annum is now over $2,000.

Beginning with the last quarter of the year most of the adverse conditions were overcome and the company entered an era of increasing net earnings, which have steadily continued. This important result, with the before mentioned development and growth, the eminent position of the company in many lines, and the large volume of orders on hand, aggregating over $15,478,000 on June 30, 1907, is evidence of future prosperity.

Following are extracts from the annual report by President Whiteside to the stockholders of the company:

"During the past year much attention has been devoted to systematizing the work of the engineering department; improving and simplifying standard designs, thereby reducing cost of production and installation without impairing efficiency or sacrificing quality; perfecting new designs, which has greatly taxed our facilities for several years, as

indicated in previous reports; and at the same time effecting economies and that close co-operation with the other departments so necessary to a proper conduct of the business.

"Development work in our several new lines of machinery, namely, gas engines, hydraulic turbines, steam turbines, turbo-generators, induction motors, transformers, etc., has been carried to practical completion, and has been extraordinarily large because of the wide range in the standard sizes and types adopted. The uniformly successful results that have been attained in practical operation, and demonstrated by various tests, are gratifying in the extreme, and it may be safely stated that the accomplishments of the past year mark an important step in advancing the engineering reputation of your company and strengthening its position in the trade.

"In order to protect our new and important designs in machinery and auxiliary devices, numerous applications have been made for letters patent covering many novel yet valuable features. A larger number of patents than ever before has been issued to the company, and healthy activity in this direction is manifest throughout the entire engineering organization.

"The past year has been marked by a very considerable increase in the sale of the products of the electrical and steam turbine departments, in connection with the sale of our other products to regular, as well as to many new customers. Thus we have introduced our electrical apparatus and steam turbines where other types were used exclusively.

Steam Turbines.

"Probably the most important work which has been brought to a commercial consummation has been in the development of our steam turbine units, the unique features of which are fully protected by various patents owned by the company. In 1903 we designed and built our first turbo-generator, and its detail has required no material change—a strong testimony to the scientific accuracy of the principles first adopted. It is asserted with confidence that our turbo-generators are the best designed and most efficient machines on the American market. Sizes ranging from 500 to 7,500 kilowatts have been completed and tested, and the success of these units under actual operating conditions is thoroughly established.

"Notwithstanding our recent advent into this field our sales of steam turbines have already reached nearly 100,000 kilowatt normal capacity, and compared with the previous year, show in orders booked an increase of $800,000.

Gas Engines.

"In this important branch of our business substantial progress has been made. Each of our standard sizes has been designed, constructed and installed during the year, and our first gas engines are in successful operation.

"Orders to August 1, 1907, for the horizontal, twin-tandem and double-acting type of gas engines, ranging in capacity from 500 to 5,000 horsepower, aggregate 189,350 horsepower.

"One of our notable contracts covers the electrification of a steel plant requiring gas engine electrical units of an aggregate capacity approximately 60,000 horsepower. This order is believed to be the forerunner of a great many others of similar character, because of the great saving effected by this means in the utilization of gases produced in the manufacture of steel and hitherto wasted.

"Another important contract, which has been awarded us by an electric railway company, is for traction purposes the largest installation in America of electrical units driven by gas engines to operate on producer gas. The equipment comprises three horizontal, twin-tandem gas engines of 1,500 horsepower each, direct-connected to 1,000 kilowatt, 3-phase, 25-cycle alternators of our manufacture, and includes all sub-station apparatus.

Hydraulic Turbines.

"Although we have but recently undertaken the manufacture of hydraulic turbines, we installed and placed in operation during the year ten complete hydro-electric plants, having a combined output of 105,000 horsepower, and it is gratifying to report duplicate orders from the largest companies interested in these plants. Particular reference is made to the highly satisfactory performance of a 32,000-horsepower installation furnished one of the largest water-power developments in the south, for which we have recently contracted to supply six additional units of identical design.

Air Brakes.

"This department was organized about July 1, 1906, to exploit the sale of air brake equipments, pursuant to an arrangement made with Mr. N. A. Christensen, inventor, whereby your company possesses the exclusive patent rights to manufacture and sell the 'Christensen' air brakes to urban and interurban electric railways. The 'Christensen' brake has been extensively used for years, and its merits are widely recognized. A reasonable degree of success has already rewarded our efforts to establish ourselves in this line of business.

Electrical Apparatus.

"During the past year we have completed the development and manufacture of large alternating current and direct current generators, rotary converters, induction and direct current motors in all sizes and capacities, transformers for both power and lighting service, street railway motor equipments and electric hoists; all of which are in successful operation.

Steam Engines.

"It is worthy of note that notwithstanding the large inroads made by the steam turbine and gas engine, our Corliss engine business continues in steady volume, particularly for the medium and smaller sizes."

IMPORTANT NOTICE.

For the purpose of facilitating the disposition of a matter of great interest to hydro-electric companies, and to be sure that we have at our disposal the proper names of not only the corporations, but their presidents and secretaries as well, we would like to receive at the very earliest convenience from all the electric companies operating West of the Rocky Mountains, their proper corporate name, together with the names of their respective presidents and secretaries.

The reason for asking for this information is of vital importance to every hydro-electric power company throughout the West, and an immediate reply is urgently requested. Legislation at Washington at this next session of Congress will undoubtedly make it advisable for an organization of your companies to be formed. Personal letters will be sent you upon receipt of the above information.

JOURNAL OF ELECTRICITY, POWER & GAS.

NEWS NOTES

POWER AND LIGHT.

Pocatello, Idaho.—The Idaho Consolidated Power Company, with a capital of $2,000,000, has absorbed the American Falls Power, Light & Water Company, the Pocatello Electric Light & Power Company and the Blackfoot Power & Water Company. The formal transfer of these holdings to James H. Brady of this city will be made in a few days. Mr. Brady retains the presidency of the Consolidated Company. The plans include the development of the Consolidated's ownership of 50,000 horsepower at American Falls and transmission of electrical energy to the surrounding towns. Twenty-five hundred horsepower is now being generated at American Falls and an additional 4000 can be placed on the wires inside of sixty days.

St. Johns, Ore.—S. V. Davidor, of the St. John Gas Heating & Lighting Co., announced yesterday that the company had let the contract for the gas machinery and holder to the Seattle Machinery Co. for $21,000, to be delivered within three months. Mr. Davidor further announced that gas would be delivered to consumers in St. John within four and one-half months. Ground for the buildings for the plant will be broken one month in advance of the delivery of the machinery, on the site of the St. John Steel Ship Co., recently purchased by the new company for $8,000. Men are at work in St. John making measurements for the pipe lines of the plant, the intention being to hasten the work of construction in all lines.

Billings, Mont.—As a result of a meeting of the Fire, Water and Light Committee of the City Council, the proposition of Yegen Bros. to light the city for the next ten years was accepted and will be recommended to the Council at the next regular meeting of that body. It is said that the company will install the Westinghouse system. The lights will be of the 3,000-candlepower variety. Work of setting poles and preparing for the installation of the new system will commence at once. Power will be furnished by the new electric light plant recently built by the Yegens on the Yellowstone River, a short distance southeast of the city. At the same meeting of the Fire, Light and Water Committee, the question of granting a gas franchise to John D. Losekamp was considered, and the proposition will also be reported favorably to the Council at its next meeting. In case the Council sees the matter in the same light that the committee has, a special election will be held for the purpose of giving the people an opportunity of voting on the question. The petitioner agrees to furnish gas at the rate of $1.50 per thousand feet, and this rate will be increased during the life of the franchise, which will be twenty-five years. If the proposition meets with favor at the polls, actual work of laying the pipe line and building the plant will begin next spring.

ILLUMINATION.

Quincy.—E. D. Bannister is talking of building a power plant to supply Genesee Valley mining district.

Pasadena.—In addition to the call proposed for the water system bonds, an issue of at least $200,000 is needed for the light plant under the plans.

Newark.—George C. Higgins, representing San Francisco capital, has applied to the Board of Supervisors for a franchise to erect a gas plant at this place.

Los Angeles.—A proposition has been made by president Driffill of the Ventura County Power Co. to the people of the Ojai Valley, that the company will immediately install the plant if the people will subscribe for the stock necessary to pay half the cost.

San Bernardino.—Carl F. Schrader has filed a petition with the Board of Supervisors for a franchise for a gas and electric light system in the town of Needles. He will obtain electric power from the Victo and Virgin Mining Company. He also intends to put in a gas plant.

Los Angeles.—The plans for illuminating the pier have been prepared by City Electrician Desmond; one providing for a series of arches and the other for a row of ornamental posts. The estimated cost of the former plan is $700, and the latter, $1000. The City Council has the matter under consideration.

Glendale.—The site has been obtained by the Southern California Gas Circuit Company for the proposed new gas plant. The directors of the company are: Berchtold Baruch, president; Herman Cohn, first vice-president; James E. Hellman, second vice-president; M. N. Newmark, treasurer, and Samuel T. Mock, secretary and attorney.

Los Angeles.—In the matter of the electric light proposition, it is believed that nothing will be done in the direction of commercial lighting until the pending Edison suits are settled and another bond issue is put through, if such a move is decided necessary. A local authority states the municipal plant will soon be fully equipped to take care of the street lights now in. Those in charge say that with the material contracted for, including a contract for about $10,000 for transformers, about to be closed, will exhaust all funds available and this is the reason given for stopping all further work.

TELEPHONE AND TELEGRAPH.

Los Angeles.—The contract for the copper wire for the Aqueduct power telephone and trolley lines has been closed by the Board of Public Works, with John A. Roebling's Sons Company, Trenton, N. J., at prices ranging from $17.50 to $17.85 per 100 pounds, which will amount to between $60,000 and $65,000.

POWER AND LIGHT.

Stevensville, Mont.—An electric light franchise was granted to H. C. Hodge. The lighting system will probably be in operation about the first of the year.

Hailey, Ida.—Work was begun on Trail Creek on the dam and headgates for the power plant of the Independent Mining Co. The plant will be built by contract, and will cost $30,000. It is to be ready for use by the first of June, 1908.

Snohomish, Wash.—P. E. Hall, of Everett Gas Company, was in the city this week and stated positively that before the sixteen months allowed by the terms of his contract shall have expired, the gas mains will be laid from Everett and gas pumped to Snohomish patrons.

Great Falls, Mont.—Announcement was made yesterday by Attorney Fletcher Maddox, counsel for W. D. Darst & Sons, of Chicago, that his clients had decided not to accept the franchise that the voters of the city had granted them for the establishment and maintenance of a gas plant in Great Falls.

Albany, Wash.—At the Council meeting last week the formal acceptance of the gas ordinance by Jas. Steel was read, also that of A. Welch accepting the terms of the electric line franchise; the bond has been filed but not yet accepted. The gas franchise acceptance was ordered recorded.

Chehalis, Wash.—B. H. Petley appeared before the City Council with an ordinance granting himself and associates a twenty-five-year franchise. Petley recently has been granted a franchise by the Centralia Council. The company promises the city 2 per cent of its gross receipts during the life of the franchise.

North Yakima, Wash.—The local trolley company is figuring on securing power from the Tieton River. The right to use the river for this or other purposes is vested in the Tieton Waterusers' Association, and as the personnel of the stockholders in the association and in the trolley company is almost identical, it is not likely that much opposition will develop. The company's engineer says that 3000 horsepower can be developed from the river.

Uniontown, Wash.—The Idaho-Washington Company has a crew of men here unloading poles and wire, and active work on the construction of the electric light line has begun. The main line from Lewiston to Moscow will be tapped about three miles east of this place. The right of way across the numerous farms has been secured and the work of setting poles has already begun. President M. J. Shields said that the line would be completed and the power ready for use inside of three weeks. A crew of men will be here in a day or two to wire the town.

Washtucna, Wash.—S. M. Glenn, a wealthy rancher of this city, proposes to establish an electric plant at the little falls of the Palouse River, which will furnish business houses at Washtucna and all the homes in the coulee with lights. A canvass by Mr. Glenn has shown that to establish a plant, using the falls as the motive power, would be financially feasible. The estimated cost of the plant alone is $4,000, and it is believed that its maintenance would be inexpensive.

Phillipsburg, Mont.—The Granite Power and Light Co. is the name of a new Granite County corporation that filed its articles with the Secretary of State in Helena this week. The company is capitalized for $250,000, in shares of $5 each. The directors are Charles H. Savage, of Butte; Willard Bennett, of Helena; M. E. Estep, of Chicago, and J. B. Featherman, of Drummond. The company is to operate a power plant on Flint Creek, in the vicinity of Stone Station to furnish electric power and light for the mines, in that vicinity, especially in the Smart Creek district where extensive mining operations are contemplated.

Spokane, Wash.—Dr. F. O. Hudnutt, general manager of the Multnomah Mining, Milling and Development Co., who spent Friday in the city on his way East, said: "Our company has just completed the construction of a dam across the Nespelim River, and in a short time we will begin the construction of a power plant costing about $10,000. Our company owns 300 acres at the mouth of the river, and we will be able to generate 500 horsepower. Our company expects to continue the development of the property, but we will not ship any more ore until there is a reduction in transportation rates, or until we have erected a plant for the treatment of our own ores.

Wallace, Ida.—The 22-inch pipe line from the dam on Placer Creek to the power plant of the Wallace Light & Water Co. will be completed in a short time. All of the pipe has been shipped from the coast, and the last car will arrive in a few days. Over 7,000 feet of the line is finished, and the work on the upper end is being pushed as rapidly as possible. Considerable delay has been experienced in securing pipe as fast as needed. The line is approximately 9,500 feet in length, being constructed of 22-inch wood pipe, which is wrapped with heavy wire and coated with tar. There is a fall of 230 feet from the dam to the power house, and the pressure will be about 140 pounds to the square inch. When there is a full head of water nearly 400 horsepower can be generated, but there are five months in the year when there is very little water, and the dynamo has to be driven by steam.

Prosser, Wash.—The Prosser Traction Company, organized several months ago to construct an electric railway in this section, is preparing to file papers for a power right on the Yakima River. Frederick Finn, representing the company, announced that the traction company has selected a power site seven miles below Prosser with the intention of securing it for that purpose. In case it secures the site, the company will construct a dam and build a power plant at that place, transmitting its power to Prosser. The Prosser Traction Company now holds two franchises, one from this city and one from Benton County. It is proposed to construct a line south into the Horse Heaven country as far as the Columbia River, and another east to connect with the North Coast Railroad in case that road builds its line as now proposed, through Kiona and up the Yakima Valley. Mr. Finn said that his company will have surveyors out within a few weeks. With the exception of some land on the north of Prosser, the company has no right of way as yet.

ELECTRIC RAILWAYS.

Coeur d'Alene, Idaho.—F. L. Wells, right of way agent for the proposed electric line to Wallace, returned home last night and states the right of way in most part is obtained between Coeur d'Alene and the Coeur d'Alene River points.

North Yakima, Wash.—The Yakima Transportation Company hopes to secure from the Tieton Waterusers' Association permission to use the river for power purposes. According to the plans of the company, the railway ultimately will be constructed as far as Sunnyside, thirty-four miles away.

Seattle.—The Seattle Electric Co. will not begin work upon the extension of the Alki Point line a mile and a half further toward the point until January 1st. This is the report which a committee of the Alki Point Improvement Club brought to the organization at its meeting last evening in Richter's Hall from general manager H. F. Grant.

Tacoma.—Surveyors in the employ of the Tacoma Railway & Power Company are engaged in running a line from the present terminus of the American Lake line of the company's suburban system, in the direction of Olympia. The survey follows closely the route of the Pierce County road until it crosses the Nisqually River. Thence it passes the plant being erected by the Dupont Powder Company, and heads straight for the capital city.

Everett, Wash.—Flat denial is given to the recently published statement that the Seattle-Everett interurban trolley line has passed into the hands of the Stone-Webster Co. Further than this, Fred E. Sander, promoter and builder of the road, makes positive statement that his holdings are not for sale, that he expects to complete the trolley communication between Seattle and Everett, and gives the assurance that he is to-day making money on his investment.

Seattle.—The Loyal Railway Company, of Ballard, began work on the extension of its line out Broadway last week. The line runs out to Tenth avenue, thence north to the new pleasure resort now building, Golden Gardens, which is owned by the Loyal Railway Company. The road will cross the low ground between Fourth Avenue and the Brygger Hill on trestle work and not wait for the street to be filled. The right of way has been condemned, and it had been planned to improve the street, but the cut was so deep and the expense so heavy that the largest property owners objected and stopped the work.

Pullman, Wash.—Now the Whitman Electric Railroad Company has resumed work on its line from Colfax to Pullman, and is grading several miles of roadbed on Spring Flat, this side of Colfax. The company is making arrangements for traffic exchange at Colfax with other roads and promises to build and equip the road and have it running into Pullman next year, if the people of Pullman will assist in securing right of way and building the road. Colfax citizens are taking an active interest in the building of the road and are desirous of having closer connection and better service between Colfax and Pullman, the two largest towns of the county. Efforts are being made looking to the building of a connecting link between the Whitman electric and the Pullman, La Crosse & Columbia River road, which will give Colfax connection with the Northern Pacific and open

Conconully, Wash.—A move is on foot for resuming activity in surveying and locating the Okanogan Electric Railway Company's lines in this county. A proposition comes from the officers of the company, at Spokane, to the effect that if the people along the line of the proposed railway will subscribe for a liberal share of the stock of the company, to be paid for in installments after the road is built and in operation one year, parties in Spokane will advance money immediately for preliminary work and for the building of the road. Last winter and spring preliminary surveys were made and considerable right of way secured. It is proposed to build an electric line from Nighthawk, in the northern part of the county, via Loomis, Conconully, Riverside, Omak and Okanogan, to railway connection on the Okanogan River. This route would put the line in the way of large tonnage, both from rich mines and the government irrigation project on Pogue Flat. Steps are now being taken to secure the subscription asked.

Colfax, Wash.—From present indications, Colfax will, before many years, if the present plans of the men who constitute the Whitman Electric Railway & Power Company can be carried to a successful issue, be the terminus of another electric railroad. This company, which was the first electric company to be organized in the Palouse, was launched about two years ago by I. B. Harris, C. F. Stuart, S. D. Lommason, O. B. Jenkins, and L. Smuck, to construct an electric road from Colfax to Palouse, Viola and Pullman. A franchise, which is still in existence, was secured over three miles of the principal streets of Colfax, and the major portion of the right of way along the proposed line was secured after several preliminary surveys were run, to secure the most feasible grade. Since this time about five miles of grade have been constructed up Spring Flat to its intersection with the Palouse and Almota wagon road, and now the contract has been let for the building of the grade along the Palouse road to Shawnee, on the Palouse River, seven miles southeast of Colfax, and work was commenced this week.

FINANCIAL.

Porterville.—An ordinance has been passed by the trustees calling for an election on December 16th for the purpose of voting bonds with which to purchase the city waterworks.

San Diego.—The capital stock of the San Diego Electric Railway Company is soon to be increased from $500,000 to $5,000,000. It is planned to increase the trackage and build new machine shops and car shops to turn out more cars. It is rumored that the line may be run to Lakeside.

Yuba City.—Papers in a damage suit have been filed in the Superior Court at Yuba City, wherein Frank W. Cunningham demands of the Bay Counties Power Company the sum of $50,000 as damages for injuries received last October at the town of Nicolaus, when he was partially electrocuted.

Los Angeles.—The directors of the Union Oil Company, at their last regular meeting, increased the regular monthly dividend from $1 to $1.25 per share, beginning next month. This is equal to $15 per share per annum, and it is said there is a generous surplus of net earnings after the dividend payments.